SWEDISH CATALOGUE

II.

STATISTICS.

By Dr. S. A. LÖFSTRÖM,
Actuary of the Royal Swedish Statistical Central Bureau.

WORLD'S COLUMBIAN EXPOSITION
1893.
CHICAGO.

SWEDEN

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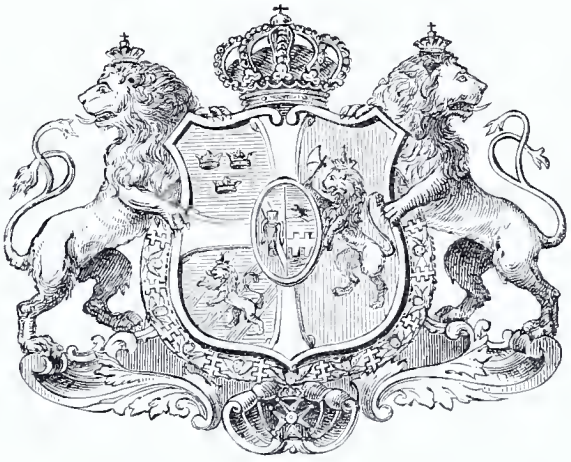

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PREFACE.

The general description of Sweden, her nature, people, and culture, forming Part II of the Swedish Catalogue for the World's Columbian Exposition at Chicago 1893, like Part I is arranged according to the classification fixed for the Exposition. The division into Departments and Groups has therefore been adhered to and where such has not been the case, the reason is to be sought in the nature and intrinsic connection of the subjects. Official reports and contributions from specialists have been the sources placed at my command. To all those who have furthered this work I beg to express my thanks, more especially to my colleague, Mr. G. Sundbärg, whose skilful assistance during the entire course of my labours has been invaluable to me.

The editor.

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SWEDEN.

SITUATION, FRONTIERS, AND AREA.

The Kingdom of Sweden, politically united with Norway and ruled by the same king, has an area of more than 440,000 sq. kilom., or about 170,000 sq. miles, and a population of not quite 5 millions.

Sweden shares with Norway that land, so well defined by nature, which is called the Scandinavian Peninsula and forms the utmost projection of the European continent to the north-west between the Ocean and the Baltic, the inland sea of Northern Europe. Sweden makes up the eastern and larger part (58 per cent) of this peninsula, extending from 69° 3′ 21″ to 55° 20′ 18″ N. Lat. — a situation which corresponds to that of the territory of Alaska on the continent of North America — and between 11° 6′ 19″ and 24° 9′ 11″ east from Greenwich.

The greatest *length* of Sweden, 1,600 kilom. (about 1,000 miles) falls on a line which in the north stretches a good way into the Arctic zone, and in the south reaches to below the north-eastern extremity of Prussia, while the greatest *breadth*, about 400 kilom. (250 miles), falls on that parallel on which Haparanda, the most northern town of Sweden, is situated.

The whole *circumference*, exclusive of the many fiords which run up into the land, is 4,600 kilom. (2,860 miles) of which 2,500 kilom. fall upon the coast along the Baltic and North Sea, and 2,100 kilom. upon the boundary line in the west and north (1,600 kilom. upon the dividing line between Sweden and Norway, 500 kilom. on the frontier between Sweden and Finland). A great number of islands form part of this kingdom, of which the two largest, Gotland and Öland, are situated in the Baltic.

The *area* of the mainland with the islands amounts to 442,126 sq. kilom. (170,660 sq. miles), of which about one twelfth, or as much as the whole of Denmark, consists of water. As regards size, the united kingdoms, next to Russia, form the largest realm in Europe, Sweden itself ranking as the sixth, whilst its neighbour Russia, is eleven times larger, and if we carry the comparison across the Atlantic, we shall find that the United States of North America are twenty-one times the size of Sweden, while the latter country is three times as large as the state of Illinois.

MOUNTAINS, PLAINS, AND COAST.

The *mountain regions* of Sweden have their greatest development in the northern and western parts of the country. About 8 per cent of the area of the country, forming a belt of variable breadth along the Norwegian frontier, rises to the height of 600 metres (2,000 ft) above the level of the sea; and in this region, between 65° and 68° N. Lat., in Lapland, mountain nature reigns in all its magnificence and wildness. The round forms which generally characterize Swedish fell scenery, here give place, in many instances, to sharp, or pointed crests. Vast groups of mountains alternate with isolated summits; the valleys slope precipitately, whilst the rivers gush forth and innumerable streamlets dash down the mountain sides. The general character of the landscape is similar, in many respects, to that of Switzerland, and the resemblance is greatly increased by about a hundred glaciers and their usual companions, glacier rivers, moraines, and erosions. These ice-fields cover altogether a surface of 400 sq. kilom. (155 sq. miles), or a space as large as Lake Hjelmaren and only little less than that occupied by the glaciers of the Tyrol. Some of the largest of these Swedish ice-fields are more than 6 kilom. (about 4 miles) in length.

The highest and best known summits raise their lofty peaks in Lapland, Kebnekaisse 2,136 metres (7,006 ft), Sarjektjåcko 2,125 m. (6,970 ft), Kaskasatjåcko 2,093 m. (6,865 ft), Pårsotjåcko 1,982 m. (6,500 ft), Kåtopakte 1,952 m. (6,403 ft) etc.; while more southward are Syltoppen 1,764 m. (5,786 ft), Helagsfjället 1,500 m. (4,920 ft), Åreskutan 1,419 m. (4,654 ft) and Städjan 1,176 m. (3,857 ft).

The situation of the snow-line varies in Lapland between 1,366 and 1,443 metres (4,480 and 4,733 ft), whilst farther southward there are only so-called »permanent» snow-spots, many of which, however, do not deserve that name.

From this lofty mountain region, measuring 100 kilom. (62 miles) in breadth at the upper part, and at the lower end narrowing in to the Norwegian frontier, the highland descends as a vast sloping plateau towards the Gulf of Bothnia and the great lakes in Central Sweden, gradually sinking in both directions to a more or less broken lowland. The upper part of this plateau inclines very gradually and contains many large lakes and enormous marshes; then the lakes decrease in size, the valleys become steeper and the mountains are completely covered with forests, and finally the coast landscape commences, with its broad glens and numerous traces of the former intrusion of the sea. Over all this plateau, arms or branches from the fells, or mountains, are to be seen in the form of broad ridges, many falling away some distance from the coast, others, on the contrary, stretching as far as to the sea, disperse into rich groups of islands, or force themselves between the great lakes and become united to the lower plateau of mountains and woods which occupies a part of the south of Sweden.

The *lowland* occupies a part of the littoral along the Gulf of Bothnia, and appears farther south in the natural depression, which is marked by the lakes in Central Sweden and contains the plains of Upland, Westmanland, Westergötland and Östergötland; and again in the plains which surround the wooded plateau of Småland, and of which that of Skåne is the most important.

The character of this flat country is considerably diversified in the south of Sweden by remarkable interruptions — such as the mountains of Kinnekulle, Billingen, Halleberg and Hunneberg — yet still less by their height, which does not exceed 300 metres (1,000 ft), than by their geological formation. About one third of the whole area of the country lies lower than 90 m. (300 ft) above the level of the sea, and it is here that the cultivation of the soil gains ground, though under various conditions, as may be expected in a country with such differences of climate and soil as Sweden.

Numerous indentations strongly characterize the Swedish *coast*, as large and small bays with rocky shores generally penetrate far into it, thus creating a great number of natural harbours, and this irregular coast extends to innumerable rocks and islands outside the mainland, thus affording protection against the breakers of the sea. Wherever there is a collection of these islands, the Swedes call it a »skärgård», archipelago, and many such archipelagos exist on the east and west coasts, being often of considerable extent. The Stockholm archipelago, which is the largest of all, contains about 7,000 large and small islands and rocks, with a total area of over 1,000 sq. kilom. (about 400 sq. miles).

There are, however, many other rather considerable extensions of the coast, which have quite another character, the shores being low and sloping more evenly into the sea; here also the bays are fewer and form more shallow bights on the coast. This is the case, to a certain extent, round the islands of Gotland and Öland, and above all on the coasts of Skåne and Halland. There is no archipelago here, consequently the coast is much more exposed to the destructive effects of the sea.

LAKES AND RIVERS.

Next to Finland, Sweden is that country of Europe richest in inland seas, which are calculated as occupying 36,281 sq. kilom. (13,900 sq. miles), which is 8·4 per cent of the area, or more than the entire surface at present cultivated.

The largest lakes lie in the great irregular dip, or depression, which extends across the kingdom between the North Sea and the Baltic, and in an earlier geological period formed a broad channel between these two seas, but of which, owing to the elevation of the land, only some few of the larger basins now remain. The principal of these is Lake *Venern*, 5,569 sq. kilom. (2,150 sq. miles), which ranks third in size among the European lakes, being surpassed only by the Ladoga and Onega in Russia. Lake *Vettern*, 1,897 sq. kilom. (732 sq. miles), is

noted for its great depth 125 meters (410 ft) and its clear but turbulent waters. The periodical rising and falling of this lake have been the origin of very extravagant suppositions. These two lakes are of the greatest importance to the communication of Central Sweden, as they are the chief points of the principal canal system of the kingdom. Lake *Hjelmaren* formerly measured 480 sq. kilom. (185 sq. miles), but owing to the drawing off of the water, is now somewhat reduced in size; this work of tapping is the most extensive of its kind in the whole of Europe. Lake Hjelmaren, is connected with the much greater Lake *Mälaren*, 1,163 sq. kilom. (449 sq. miles), by means of a canal. This lovely Mälaren is far famed for its beauty, what with its numerous inlets running far into the land; its picturesque islands, numbering no less than 1,300, large and small; and its rocky shores, richly clad with foliage. Lake Mälaren lies only 0·3 metre (1 ft) above the level of the sea, disemboguing into a bay of the Baltic which runs up into the city of Stockholm.

Farther north there are the lakes *Siljan*, 286 sq. kilom. (110 sq. miles), *Storsjön*, 447 sq. kilom. (173 sq. miles), and the numerous Lapland lakes, e. g. *Torne träsk*, the largest of these filling the river valleys and consequently stretching out in an elongated form. Moreover, the entire country is dotted with many large and small lakes, several of which have an area of more than 100 sq. kilom. (40 sq. miles).

Sweden is as rich in rivers as in lakes, and a river, or brook, runs through almost every valley. The slope of the highland is evidently determining for the many streams of northern Sweden, which in their torrent-like course all bear towards the south-east. These rivers, having their sources in never failing masses of snow and ice, gather in numerous mountain tarns, sometimes on their course widening into extended lakes, or are pressed together between high rocky shores, subsequently to form foaming rapids. In many otherwise desolate parts of the country, the river is the only animating element, and Nature often collects, on its banks, all her richest and grandest beauties.

The *Dal* River, which flows into the southern part of the Gulf of Bothnia, is the longest river of Sweden, being 500 kilom. (311 miles), and forms a considerable fall near its outlet. Farther north, the length of the greater rivers and streams varies between 350 and 400 kilom. (220 and 250 miles). The *Ångerman* River, which, on account of its large volume of water, is the most important, measures at its outlet 3 kilom. (about 2 miles) in breadth and affords navigation to the extent of 100 kilom. (62 miles). The *Lule* River, which is its rival both in size and grandeur, is at several points from 4 to 5 kilom. ($2^1/_2$ to 3 miles) in breadth, and with only a few interruptions is navigable for 120 kilom. (75 miles). On the West Coast, the *Göta* River flows, through which Lake Wenern disembogues, and forms the famous *Trollhätta Waterfalls*, 33 metres (108 ft) in height and carrying an immense mass of water, which dashes down in numerous cataracts. The strength of the current, at this point, is calculated to be 225,000 horse-power.

There are other waterfalls, which, although rivalling the Trollhätta in splendour, are far less celebrated, viz *Harssprånget* (Hare's Leap) and *Stora Sjöfallet* (The Great Lake Fall) in the Lule River, both in Lapland, and *Tännforsen* in Jemtland, where the river in one single fall of 30 metres (100 ft), forms a foaming rapid.

Falls and torrents are also strongly characteristic of the Swedish rivers, and are caused by the varied elevations of the land. In many parts these currents are utilized in the service of man, but the greater part of this natural wealth remains unemployed, and it is not likely that it will ever be fully brought into use. In spite of the natural beauty of these falls, they deprive the rivers of the far more useful quality of being navigable, and it is doubtless due to this great defect in Swedish rivers, that the material development of the kingdom has been retarded to a certain degree. With the exception of the traffic carried on by the local rowing boats across the rivers, the inland navigation is essentially restricted to the lakes. The only clear passages to the sea are where the few canals have been made. In one respect, however, the rivers are of the greatest importance, especially in the north of Sweden, as they afford floating routes for the enormous quantities of timber, which are taken from the inland forests, and as Sweden is one of the greatest forest districts of the world, the importance of the rivers, from this point of view, may therefore easily be understood.

GEOLOGY*.

There are two very conspicuous features which explain, why Sweden, as regards the general character of its natural features, is so different from most of the other parts of Europe. The country is situated around the centrum of the ancient Scandinavian land-ice, and in the greater part of the country only two of the geological series, the oldest and the youngest, are represented. Thus the uneven, undulating surface of the rocks, belonging to the archæan series, is in general covered with the quarternary deposits of gravel, sand and clay.

Among the *Archæan rocks,* gneiss is the most common, occupying nearly all of the south-west of Sweden and a very broad belt along the East Coast, from Vestervik, south of Stockholm, all the way to the boundary of Finland. The uniformity of these districts is, however, very often broken, partly by the presence of granite, diorite, gabbro, hyperite, etc., partly by the occurrence of some finegrained rocks, which are supposed to be the youngest part of the archæan. These are hälleflintgneiss or granulite, hälleflinta, quartzite, some very interesting layers of highly metamorphosed conglomerates, mica shists clay-slates and numerous, both small and large, generally lenticular layers of crystalline limestone. From a practical point of view these rocks are more important than any others on account of their connection with the iron ores, the purest and richest of the latter occurring in the limestone,

* Contributed by H. LUNDBOHM and G. DE GEER.

hälleflinta and granulite, especially in a large belt running from east to west across the country from the Baltic to Vermland, not far from the Norwegian frontier. Though this is the principal iron bearing district of Sweden, very important iron ores are also found in other places as in Lapland, Södermanland, Östergötland.

Granite occupies most of the south-eastern part of Sweden, and besides this, it occurs as numerous massives all over the country, now very intimately connected with the gneiss and difficult to distinguish from this, now younger, breaking through the gneisses, but still of archæan age. Only a small part of the granite, occurring in Ångermanland and some other tracts, is younger, but probably precambrian.

Felsite porphyries are found as very extensive beds in Dalecarlia, and also in Småland and Norrland, forming beds and veins.

Precambrian rocks, a name applied to several groups of not fossiliferous conglomerates, sandstones, slates, and quartzites, probably equivalent to the American algonkian, are scattered over the southern part of Sweden, generally occupying only small areas, but in Dalecarlia a very extensive one. To the same period belong probably the rocks, mentioned below, of which the principal parts of the highlands of Sweden and Norway are built up.

The palæozoic series is represented only by the *Cambro-Silurian system,* but, as to the fauna, this has reached a very complete development. No less than 1,800 fossil species have been discovered in the sandstones, limestones, bituminous slates, and clay-slates, which belong to this system, and cover several, not large but very important districts in the southern and a comparatively large area in the northern part of the country. The great mountain range along the Swedish-Norwegian border offers one of the most interesting geological problems in Scandinavia. The ordinary silurian system is here overlaid by a heavy series of crystalline rocks, quartzites, and shists, which formerly have been supposed to be of postsilurian age. New investigations, however, seem to make it more presumable that this overlapping is not normal, but at least some of the crystalline rocks, probably being precambrian, were brought into their present position by an enormous overthrust, in some places not less than 60 miles broad.

Skåne, the southernmost of the provinces of Sweden, presents more variation, as to its geology, than any other part of the country. Besides the archæan and palæozoic series, the *Mesozoic* is here represented by both *Triassic*, *Jurassic* and *Cretaceous* layers, the last mentioned covering comparatively large areas. The jurassic system is very important on account of the productive beds of coal and excellent fire-clay, which occur in its lower parts. The distribution of the different systems in Skåne is largely due to great faults, crossing the country principally in North-west—South-east direction.

Among younger eruptives may be mentioned the diabases occurring as numerous beds and veins in the silurian and older systems, the nepheline syenite and the interesting melilite basalt near Sundsvall, and the post-cretaceous basalt in Skåne.

The Quarternary Deposits. The greatest part of Sweden is covered with till, in its lower parts, which rests on the rounded and striated rock surfaces, on account of its subglacial origin, forming a hard, packed ground-moraine with numerous scratched stones, in its upper parts more loose and sandy. In tracts where the till is derived from areas of silurian rocks it is often clayey, calcareous, and not very stony, forming an excellent soil.

The great areas, thus covered with morainic material, are sometimes gently, sometimes very markedly undulating, the land being furrowed by innumerable small valleys. These contain an incredible number of lakes and peat-bogs. A very good idea of this hilly and beautiful nature is given by the maps representing the coastal parts of the land, where the sea surrounds every hill, forming the celebrated »skärgård», a belt of thousands of islands and rocks.

A monument of the quarternary land-ice, not less conspicuous than the till and the scratched rocks, etc, is seen in the famous ridges of sand and gravel, which are called »*åsar*». Probably formed in tunnels and channels in the melting landice, they form a great riverlike system of meandering and often confluent ridges, running as the general slope of the land, generally following the valleys but also passing over heights, which may be in their way. Some of these ridges can be traced 200 or 250 miles in length, being up to 100—150 feet high. Part of the city of Stockholm is built upon one of these ridges. The gravel is generally of an excellent quality and is often used in the construction of roads, etc.

At the close of the glacial period the lower parts of Sweden were submerged below the sea, the subsidence being greater in the central region and smaller in the more peripherical parts of Scandinavia. During this subsidence considerable masses of glacial clay and sand were deposited, now covering the larger plains and the valleys in all the submerged tracts. After the formation of these layers, which are characterized by an arctic fauna, the land emerged to a somewhat higher level than at present, while the climate was growing milder. During this time the first inhabitants immigrated to Sweden.

But once more a submergence followed, though not so great as the earlier, and from this the younger marine clay and sand, occurring in the lowest part of the land, is derived. In these post-glacial deposits the same fauna is found as that actually living on our coasts, with the addition of a few forms, which have now become extinct in these latitudes, showing, together with similar evidence from the flora in the peat-bogs, that the climate, after this stage of the post-glacial time, had become slightly colder.

The marine sediments form the best and most easily tillable soil in Sweden and are also for the most part employed for agriculture. Thus there is a very close connection between the extension of the ancient sea-bottom and the most cultivated and densily populated parts of the country. As soon as we leave the once submerged tracts, the large continuous fields generally disappear and the cultivated area occurs, with some exceptions, only as smaller, irregular patches on the

ledges of the mountains, most of the tilly ground being devoted to forests. In later years several successful attempts have been made to cultivate the numerous peat-bogs on a large scale and in a more rational way, and in the course of time this will no doubt partly obliterate the distinction between the tracts below and above the limit of the submergence, which distinction now affords one of the most striking examples of the direct bearing of the geological changes in the past on man and his prosperity.

CLIMATE.

The climate of Sweden is severe, although much milder than might be expected, judging from the northern situation and high latitude of the country. Barley and rye are cultivated within the Polar circle and dense forests cover Sweden in the very same latitude in which Greenland is wrapped in eternal ice. It would be difficult to say how far this fortunate fact is to be attributed to the influence of the Gulf Stream, which runs along the Norwegian coast, but its tempering influence is generally taken for granted.

It is also evident that the great extent of the country, which from north to south embraces more than 14 degrees of latitude, as well as the various heights, must tend to produce climatic differences which are sometimes marked by great contrasts. In Lapland, for instance, it is not unusual to find, even in the height of summer, a bog frozen to the bottom; while, on the other hand, apricots and peaches ripen in Skåne in the open air.

Observations for the period 1860—1890 give the following figures for the *mean yearly temperature:* in Jockmock, within the Polar circle, — 1·22° Celsius; Haparanda + 0·2° C.; Falun + 3·9° C.; Gefle + 4·3° C.; Stockholm + 5·3° C.; Jönköping + 5·8° C.; Lund + 6·9° C.

In regard to climate, the distance from the Atlantic also plays an important part. The inland country, as well as the littoral of the Gulf of Bothnia, shows a typical mainland climate, with clear air, warm summers, and severe winters. All the harbours on the East Coast are more or less blocked by ice in winter, but the West Coast, on the contrary, enjoys an island climate on the whole, with cool fresh summers and mild winters, the harbours being generally free from ice. The farther east, the greater are the extremes of temperature in the same latitude, but the greatest difference occurs, however, in the interior of Northern Sweden, where the variation amounts to more than 70° C., or from + 30° C., on a warm summer day, to — 40° C. and under, at which temperature mercury becomes frozen, a not unusual occurrence.

The same difference may be remarked in the *rainfall*, which is generally more abundant on the West than on the East Coast. During the period 1860—1890 the rainfall had its average maximum in Göteborg, 768 millimetres and its minimum in Kalmar, 365 millim., while the figures for all the country amounted to

about 500 millim. The belt of the archipelago on the East Coast is among the districts where the least rain falls.

The great contrast of climate between the northern and southern parts of Sweden have naturally had great influence on the material cultivation of the country. Thus the great centres of agriculture are to be found in the southern half of the kingdom, whereas the northern half does not produce sufficient corn for its own requirements. Notwithstanding this latter fact, the cultivation of the soil does make progress even there, and is much favoured by the short but warm summers, and the clear nights, which make the crops grow and ripen in a remarkably short time. A considerable inconvenience, however, is that sometimes after a warm, clear summer-day, the frost will destroy the growing crops in a single night; therefore the failure of the harvest is not a very uncommon occurrence. But on the other hand, the winter, by bridging over the lakes and rivers and covering the entire country with snow, is of immense importance for intercommunication which, more especially in mining and timber districts, is far greater than during the summer.

In many parts of the kingdom, a winter without snow is a far greater misfortune than the failure of crops. It is only on the plains, where the snow has accumulated unevenly, through fierce storms, that it sometimes hinders traffic.

POPULATION.

The Swedish people are supposed to have lived in the land they still inhabit for at least 4,000 years, during this entire period not having assimilated other nationalities, or at least to no extent worth mentioning, so that the Swedish nation — as the Norwegian and Danish — is of an origin far purer than any other at present existing outside of Scandinavia.

The kingdom of Sweden is the most ancient of the States still extant in Europe, for all historical monuments prove that the Swedes have kept to about their present territory perfectly independent of foreign nations, probably for a long time divided into lesser communities, but for the past 1,200 years united to a single realm.

The Swedish state has experienced great vicissitudes; during the celebrated Viking period (800—1000) the Swedes directed their expeditions towards the east, founding there the Russian kingdom, which later on became so vast an empire, and among the best families of which, several may be counted as of Swedish extraction. During the earlier Middle Ages, Sweden, after the conquest of the present Grand Duchy of Finland, gave it Germanic culture and no slight portion of its inhabitants, which now, Swedes and Finns, seem about to combine in forming one of the most vigorous nations of Europe. The extreme outpost of western civilization towards the east was thus planted in Finland by Sweden.

During the later Middle Ages Sweden, Norway, and Denmark entered upon

the treaty which is known as the Union of Calmar (1389—1521), but the conditions being disregarded by the Danes, after a bitter contest, which lasted for nearly a century, the Swedes broke loose from the union and resumed their solitary state under the famous Wasa dynasty (1521—1654).

In the reign of the greatest of all the Wasa kings, Gustavus Adolphus, (1611—1632) Sweden, by participating in the Thirty Years' War, saved the cause of liberty of conscience in Europe; thanks to these events, for a short time, she became a great power and ruled over the more important part of the Baltic shores. It was, however, impossible for a nation consisting of less than 2 million inhabitants to keep the position of a great power, so after a glorious struggle (1700—1718) with all her neighbours, during the reign of the celebrated Charles XII, Sweden was obliged to give up her possessions beyond the Baltic, the last of them, however, Finland, being retained until 1810.

In 1814 the union with Norway was effected, since which time Sweden and Norway form a very extensive realm (close upon 300,000 sq. miles) with not quite 7 million inhabitants, Sweden having almost 5 millions.

In the territory at present belonging to Sweden the population is considered as having been in:

Year.	Population.	Year.	Population.
1570	670,000	1800	2,350,000
1700	1,400,000	1815	2,465,000
1720	1,300,000	1865	4,114,000
1750	1,780,000	1892	4,820,000

Ever since 1865, the increase of the population has been much weakened by vast emigration, of which more anon. The surplus of births to deaths is yearly about 60,000, but the increase of population is but a third of this figure, the rest finding their way to other countries, chiefly to the United States. Since 1865, Sweden has lost about 700,000 individuals by emigration, and remembering this, and the vast Swedish population in Finland, as also in Norway and Denmark, it may be taken for granted that, though Sweden has barely five million inhabitants, yet the Swedish language is the mother tongue of at least 6 million individuals.

Other nations are represented in Sweden by a very small number of Lapplanders (about 6,000) and Finns (about 20,000) both races living in the far north, as also a very small number of foreigners settled here (altogether about 20,000 persons) chiefly from those countries nearest us. More than 99 per cent of the population of Sweden consists of native Swedes.

As regards *faith*, the population is almost as homogenous, the Lutheran creed being that of the National Church of Sweden, and no less than 99·9 per cent belong to Protestant denominations. During the last decades several sects have become more widely spread, as at present there are about 40,000 Baptists, close upon 20,000 Methodists, and a couple of thousand members of the Salvation Army, etc. Moreover, one or two special denominations have arisen in Sweden,

and, though based on Protestant principles, have as regards their worship and rituals — as also in some degree in respect to creed — emancipated themselves from the Swedish Church. The members of these two denominations — each reckoning some hundred thousand adherents — still belong to the National Church in name.

The Church of Rome has about 1,000 adherents and the Jews number about 3,000.

DIVISION. PRINCIPAL TOWNS.

For purposes of administration, Sweden is divided into 25 provinces or «Län», the capital Stockholm forming one of itself. The area and population of these provinces were as follows in 1891:

Provinces (Län).	Area.		Population 1891.			Inhabitants pr	
	Square kilom.	Square mile.	Urban.	Rural.	Total.	Square kilom.	Square mile.
Stockholm, town..	33	13	250,528	—	250,528	7,600	19,300
Stockholm	7,791	3,007	10,957	142,393	153,350	20	51
Upsala.....	5,316	2,052	24,815	96,769	121,584	23	59
Södermanland ..	6,813	2,630	21,780	133,995	155,775	23	59
Östergötland ..	11,066	4,271	54,440	212,205	266,645	24	62
Jönköping	11,500	4,439	24,164	169,220	193,384	17	44
Kronoberg	9,949	3,840	6,673	153,171	159,844	16	42
Kalmar	11,497	4,438	27,530	203,860	231,390	20	52
Gotland	3,116	1,203	7,138	44,030	51,168	16	43
Blekinge.....	3,015	1,164	31,451	111,057	142,508	47	122
Kristianstad	6,493	2,506	13,590	207,121	220,711	34	88
Malmöhus	4,783	1,846	109,615	261,002	370,617	77	201
Halland	4,919	1,899	20,863	115,455	136,318	28	72
Göteborg & Bohus	5,057	1,952	119,303	181,158	300,461	59	154
Elfsborg	12,815	4,947	20,923	253,128	274,051	21	55
Skaraborg	8,503	3,282	20,885	224,700	245,585	29	75
Vermland	19,025	7,344	17,937	235,372	253,309	13	34
Örebro..... .	9,072	3,502	19,233	164,161	183,394	20	52
Vestmanland	6,794	2,622	22,640	115,252	137,892	20	52
Kopparberg.....	29,579	11,417	10,275	189,320	199,595	7	17
Gefleborg	19,214	7,417	39,074	170,428	209,502	11	28
Vesternorrland ..	24,655	9,517	19,809	191,994	211,803	9	22
Jemtland	50,771	19,598	5,332	95,727	101,059	2	5
Vesterbotten	56,828	21,936	4,648	120,988	125,636	2	6
Norrbotten	104,413	40,303	9,062	97,580	106,642	1	3
The four large lakes	9,109	3,516	—	—	—	—	—
Total	442,126	170,661	912,665	3,890,086	4,802,751	11	28

Norrbotten — the largest of all the Swedish provinces, being 40,000 sq. miles — is about as large as Ohio, and the two most northern provinces (Norrbotten and

Westerbotten, together 62,000 sq. m.) are somewhat larger than Illinois. These two provinces embrace the whole of the utmost north of Sweden and occupy one third of the entire area of the kingdom, but together contain only 230,000 inhabitants, or less than $^1/_{20}$ of the entire population of the country. Half the inhabitants of Sweden live in the fifth part of the country lying farthest south.

The southernmost province, Malmöhus (1,850 sq. m. and 370,000 inhabitants) is more densely populated than France, as a general rule, and can well bear comparison in that respect with the State of New Jersey in the United States.

During the last decades, the increase in population has been much more rapid in the northern than in the central and southern parts of Sweden. The five provinces that are farthest north (last five in the above table), which collectively are generally called Norrland, had in 1870 not quite 520,000 inhabitants, but in 1891 more than 755,000, an increase e. g. fully comparable to that of the State of Connecticut U. S. A. during the same period. Norrland, therefore, with its wide expanse of unreclaimed land, extensive meadowland, and vast forests, and its inexhaustible supply of ore (Gellivara ferriferous mountain), is rightly called the America of Sweden.

The population of Sweden is essentially rural, though the number of inhabitants in the towns has largely increased of late, as will be seen from following figures:

Year.	Population of Sweden.	Rural.	Urban.	Pop. of towns % of entire kingdom.
1840	3,138,887	2,835,204	303,683	9·67 %
1850	3,482,541	3,131,015	351,526	10·09 »
1860	3,859,728	3,425,209	434,519	11·26 »
1870.....	4,168,525	3,628,876	539,649	12·95 »
1880.	4,565,668	3,875,237	690,431	15·12 »
1891	4,802,751	3,890,086	912,665	19·00 »

There are in Sweden nine towns with 20,000 inhabitants or more; the increase of population is shown by following figures:

	1860.	*1870.*	*1880.*	*1891.*
Stockholm	112,391	136,016	168,775	250,528
Gothenburg	37,043	56,288	76,401	106,518
Malmö.....	18,919	25,593	38,054	49,402
Norrköping	19,956	23,850	26,735	33,431
Gefle	10,975	13,822	18,758	24,337
Upsala.....	8,459	11,433	15,675	21,441
Helsingborg	5,333	7,941	11,550	20,897
Karlskrona	15,300	16,558	18,300	20,892
Jönköping	7,444	10,879	16,147	19,776

Including the suburbs, Gothenburg — the chief town of Western Sweden and most important merchantile city of the kingdom — now reckons about 120,000

inhabitants and Norrköping, a large manufacturing town, close upon 40,000. Malmö, with 50,000 inhabitants, is the most important city of Southern Sweden; Gefle, with a population of 25,000, is the largest town in Norrland; Upsala is renowned for its university, and Jönköping for its match industry («Jönköpings tändstickor»).

The following towns in Sweden had a population of from 10 to 20 thousand in 1891:

Lund 15,091	Linköping .. 12,968	Kalmar 11,822
Örebro 14,674	Landskrona ... 12,491	Eskilstuna ... 11,083
Sundsvall 13,780	Halmstad 12,282	Söderhamn ... 10,054

If the suburbs be included, Sundsvall, the great wood emporium, has close upon 20,000 inhabitants, and Eskilstuna, the chief seat of iron manufactory, close upon 15,000. Lund, like Upsala, is a university town.

In former times Sweden was divided into 24 »Landskap», originally small kingdoms, the names of which are still generally used, though they do not as a rule correspond with the modern provincial division of the kingdom. Such landskap are e. g. Skåne (comprising the provinces of Malmöhus and Kristianstad), Småland, Vestergötland, etc.

PHYSICAL AND MORAL CONDITION.

The healthy climate, combined with good social conditions, as a general rule, and riches being pretty equally distributed, makes the position of Sweden very favourable as regards its **vital statistics.** While the relative number of deaths occurring among Teutonic and Romanic races in Europe is 24 per annum to every thousand inhabitants, it is but 17 in Sweden; this being the lowest death-rate in all Europe, with the sole exception of Norway, where it is about the same.

So as to throw light on the *vitality* of the Swedish population, a comparison may be made between that of Sweden and England, whose inhabitants also enjoy very good sanitary conditions. Out of every 1,000 children of either sex born there remain alive according to the tables of mortality for 1871—1880:

	Males.		Females.	
Age.	England.	Sweden.	England.	Sweden.
0 year	1,000	1,000	1,000	1,000
5 »	734	775	763	798
15 »	696	727	725	750
25 »	657	686	685	713
35 »	599	635	629	665
50 »	477	537	521	580
60 »	365	440	423	499
70 »	222	294	277	356
80 »	77	109	109	154

Thus, at each age, the number of survivors is higher in Sweden than in England.

The death-rate has greatly decreased in Sweden during the present century, the yearly number of deaths per thousand being:

Period.	Average.	Period.	Average.
1721—1800	26·7	1841—1860	21·2
1801—1820	27·5	1861—1880	19·2
1821—1840	23·2	1881—1890	16·9

During last century each year there were 26,700 deaths per million inhabitants, while in the latest decade but 16,900.

Other data also prove that the theory of the physical degeneration of the human race is not compatible with facts, e. g. the number of men *rejected* among those examined for military service (which is compulsory for every able male in Sweden) was:

Period.	Average per cent.	Period.	Average per cent.
1831—1840	35·7	1861—1870	27·8
1841—1850	36·4	1871—1880	23·7
1851—1860	35·7	1881—1890	20 4

During the first period, we see that close upon 36 per cent of men examined were rejected, while during the latest period but 20 per cent.

The average *height* of these young men was taken and found to be:

Period.	Centimetres.	Period.	Centimetres.
1841—45	167·4	1856—60	168·1
1846—50	167·5	1861—65	168·6
1851—55	167·9	1866—70 *	169·7

The Swedes are acknowledged to be one of the tallest nations of the world. The above table proves that in this respect also, instead of the race degenerating, the contrary is the case. In Jemtland, the mean height of the conscripts was no less than 172 centimeters, and the same height has been found to be the average for scholars of the same age (20—21), though at that time of life, in this northern climate, the men are not fully developed. In fact the very next age-class 21—22 proves an increase in the mean height of conscripts of $1^1/_2$ centimeters.

Of late years, increased comfort as regards habitations has undoubtedly become noticeable, as also a decided improvement concerning food, and, as a consequence, the »standard of life» has been heightened in all classes of society. Of the nobler cereals, wheat and rye, the average yearly **consumption** for each inhabitant has been:

	Kilog. per inhab.		Bushels per inhab.	
Period.	Wheat.	Rye.	Wheat.	Rye.
1871—75	22	111	0·80	4·38
1876—80	26	116	0·95	4·58
1881—85	36	125	1·31	4·94
1886—90	38	125	1·39	4·94

* Of late years these accounts have not been revised.

From this we see that the relative consumption of wheat and rye during this period has increased from 5·18 bushels to 6·33, or more than 20 per cent.

The average consumption of coffee and sugar was:

Period.	Kilog. per inhab. Coffee.	Sugar.	Lbs per inhab. Coffee.	Sugar.
1861—65	1·71	3·55	3·77	7·83
1866—70	1·74	4·00	3·84	8·82
1871—75	2·22	5·91	4·90	13·03
1876—80	2·44	6·66	5·38	14·69
1881—85	3·03	8·13	6·68	17·93
1886—90	3·05	10·81	6·73	23·84

As regards meat and butter the consumption has universally increased, even if there be no statistics on the subject. Milk is used in Sweden to a very uncommon extent.

While the fare has improved, a very essential decrease in the consumption of *intoxicating liquors* has taken place. In this respect, Sweden, in days of yore, had not the best of names, it having been calculated that during the twenties and thirties, no less than 40 litres, or more than 10 gallons, were consumed per annum by each inhabitant. Owing, however, to a powerful temperance movement, and a reform in the laws called forth thereby, there has been so great a change that during the past thirty years the yearly consumption of ardent spirits per inhabitant (reduced to 50 per cent alcohol) has been:

Period.	Litres.	Gallons.	Period.	Litres.	Gallons.
1861—65	10·68	2·82	1876—80	10·10	2·67
1866—70	8·88	2·34	1881—85	8·00	2·11
1871—75	11·83	3·12	1886—90	6·94	1·83

As regards the use of ardent spirits, Sweden is nowadays far from ranking among those nations of Europe occupying the most unfavourable position in this respect.

The average yearly consumption of *ale* and *wine* was:

Period.	Litres per inhab. Ale.	Wine.	Gallons per inhab. Ale.	Wine.
1861—65	11·15	0·41	2·94	0·11
1866—70	10·75	0·43	2·84	0·11
1871—75	15·10	0·81	3·99	0·21
1876—80	17·27	0·72	4·56	0·19
1881—85	18·83	0·68	4·97	0·18
1886—90	23·27	0·55	6·14	0·15

As the above table shows, the consumption of ale has constantly increased during a series of years, and complaints have been made as regards its increased use as an intoxicant, but relatively, less of this beverage is drunk in Sweden than in most other countries under pretty similar conditions; moreover it must not be

forgotten that in consequence of the development of the brewing trade, the ale now offered for sale is of far better quality than before, and also that this beverage has, to a certain degree, helped to oust the very pernicious brandy.

The consumption of wine has certainly decreased during the past 20 years, but this is of less consequence, since this beverage is solely used by the wealthier classes.

In temperance literature, calculations are often made concerning the expenses of a nation for different important articles of consumption, and the sums paid for intoxicating liquors. Similar calculations have been made for Sweden, and it is computed that the annual value of the consumption for the entire nation is:

Bread	43	million dollars.
Milk	27	» »
Cheese and butter	20	» »
Sugar and syrup	12	» »
Potatoes	11	» »
Coffee, tea, and cocoa about	9	» »

while the expenses for ardent spirits and ale run to 21 million dollars and for tobacco to 5 million dollars.

The Swedish figures are far more favourable concerning intoxicants than e. g. those of England and Germany, where that article runs to the highest sum of them all, in England reaching double the sum paid for bread. As in this respect the tax is an important factor, it may be mentioned that Swedish brandy pays an excise of 50 cents and a fee of sale of about 20 cents per gallon, while ale is free of excise.

Popular education in Sweden is very advanced. At the commencement of the century a person who could not read was rarely met with, and nowadays the whole nation may be said to be able to read, with hardly a single exception. If in this respect Sweden be compared to other countries, the result is most favourable for Sweden, as will be seen from the following figures, taken from Conrad's »Handwörterbuch der Staatswissenschaften». Among the conscripts mustered, according to the very latest data, there were unable to read:

In Sweden	0·27	per cent.	In Belgium	15·38	per cent.
» Denmark	0·36	»	» Austria	38·90	»
» Germany	0·72	»	» Italy	47·22	»
» Switzerland	1·70	»	» Hungary	50·80	»
» Netherlands	9·80	»	» Russia	78·79	»
» France	12·29	»			

Sweden thus occupying very highest position among all these countries.

Crime seems to be decreasing in Sweden, as in certain other countries, at all events as regards more criminal offences. The annual number of committals for felony — or crimes that cannot be expiated by fines — was per 10,000 inhabitants:

Period.	Average.	Period.	Average.
1861—65	5·30	1876—80	3·84
1866—70	5·58	1881—85	4·02
1871—75	4·29	1886—90	3·65

It must, however, be mentioned as regards the high figures for the first two periods, that during the first an older penal code was in force, with more stringent provisos than those now valid; while during the period 1866—70 repeated failures of the crops caused great distress in many provinces. But should the comparison commence with the period 1871—75, the returns for the years 1886—90 show a decrease from 4·29 to 3·65, or more than 15 per cent. There is little doubt that this favourable result greatly depends on the previously mentioned decrease in the consumption of spirits.

But if the number of crimes has decreased, that of **suicides** in Sweden, as in most other countries, has essentially increased of late years. The number of suicides committed annually in each 100,000 inhabitants has been:

Period.	Average.	Period.	Average.
1816—40	5·89	1861—70	8·04
1841—50	6·67	1871—80	8·68
1851—60	6·37	1881—90	10·74

Curiously enough the frequency of suicide shows the greatest increase in old age, or after the fiftieth year. Among young or middle-aged married men the relative number of suicides is still about the same as sixty years ago.

The number of **births out of wedlock** in Sweden is now a little more than 10 per cent of all children born. This is a very high percentage, but it seems chiefly to depend on a rather low matrimonial frequency, especially in younger years. It has been calculated that, if the number of marriages in Sweden were as high as the average stated for Romanic and Teutonic Europe, the number of illegitimate births would not, as now, be 10 per cent of those born, but simply 7 per cent, this figure being about the average for Western Europe. Taking in consideration the total number of spinsters and widows between 20 and 45 years of age, the annual number of mothers bearing illegitimate children was per thousand:

Period.	Average.	Period.	Average.
1816—40	30·0	1861—70	36·7
1841—50	32·4	1871—80	39·4
1851—60	34·4	1881—90	36·7

The figure of the last period is 22 per cent higher than that of the first period, but simply on a par with the figure for the years 1861—70. During the past thirty years, in this respect, there has been great improvement in the towns, while in the country things are somewhat worse.

The annual number of **divorces** granted in each 100,000 inhabitants has been:

Period.	Average.	Period.	Average.
1831—40	3·51	1861—70	3·19
1841—50	3·21	1871—80	4·39
1851—60	3·30	1881—90	5·02

The Swedish figure is still one of the lowest in Europe.

The total number of living **infants born** in Sweden, from 1816 to 1890, has been annually per thousand inhabitants:

Period.	Average.	Period.	Average.
1816—40	33·11	1861—70	31·41
1841—50	31·10	1871—80	30·48
1851—60	32·79	1881—90	29·06

The decrease shown by these figures is entirely accounted for by the lesser number of marriages, as also by emigration. That matrimonial fecundity has not essentially changed, will be seen from following table showing the annual number of mothers bearing children born in wedlock, as compared with each thousand married women between 15 and 45 years of age:

Period.	Average.	Period.	Average.
1816—40	297	1861—70	293
1841—50	300	1871—80	302
1851—60	306	1881—90	292

The average for Teutonic and Romanic Europe (not including France, however) is about 300 per thousand, so about the same as in Sweden. The number of *multiple births* is greater than anywhere else in Europe, barring Finland, while the number of *still-born* (27 among 1,000 births) is very low, and since the fifties has decreased by fully one sixth.

Matrimonial frequency, as before mentioned, is pretty low in Sweden. Out of each 100 men or women of ages mentioned below, there were found, in 1880, the following number of married persons:

	Males.		Females.	
Age.	Western Europe.	Sweden.	Western Europe.	Sweden.
15—20	0·2	0·0	3·4	1·1
20—25	11·8	7·6	31·6	17·6
25—30	49·3	40·0	62·5	47·7
30—35	71·6	66·2	74·4	65·3
35—40	80·0	78·3	77·4	72·6
40—45	82·7	82·9	75·7	73·5

Not until the age class 40—45 does Sweden show the same proportion of married men as Teutonic and Romanic Europe has, as a general rule. As to the

women, the figures are still more unfavourable, owing to the fact of their numerical excess in Sweden being unusually large, a state of things which has, of late years, been still further augmented by emigration. The number of *marriages* annually contracted per 1,000 inhabitants has been:

Period.	Average.	Period.	Average.
1816—40	7·85	1861—70	6·54
1841—50	7·27	1871—80	6·81
1851—60	7·61	1881—90	6·26

If first marriages be considered, and their frequency compared with the bachelor population of a certain age, it will be found that the annual number of men, who entered into wedlock for first time, of every 1,000 bachelors between 20—50 years of age, was:

Period.	Average.	Period.	Average.
1816—40	94	1861—70	70
1841—50	77	1871—80	75
1851—60	77	1881—90	69

It must not be imagined, however, that the married population has decreased relatively to such an extent as the number of marriages entered upon. Thanks to the great decrease in mortality, the duration of wedded life has been greatly prolonged, moreover, emigration has likewise helped to keep up the relative number of married people, since emigration is chiefly undertaken by single persons.

EMIGRATION.

Those causes, which have brought about a decrease of marriages entered upon, are in fact chiefly those which have occasioned emigration. Far distant from the trade centres of the world, of vast extent, and in want of capital, Sweden, in spite of her many rich products of nature, has been unable to proceed to that division of labour and mass production which nowadays is called for, as speedily as other countries which have a more favourable situation, are more densely populated, and possess a greater number of capitalists. During the lengthy transition that has ensued, Sweden could not but suffer from a competition with those nations, a competition which, at all events for the time being, has proved it self overpowering. Another factor of great importance is the difficulty experienced by the Swedish farm labourer, to which class the bulk of emigrants belong, in attaining the position of landowner, a position which he hopes to acquire in the New World. These are, we believe, the essential reasons why several hundred thousand Swedes, during recent decades, have been obliged to seek a sphere of activity abroad, which they could not obtain at home, or which, at all events, did not offer them those economical advantages, which nowadays a man demands of his work. Increased development of industry and social conditions, will, we trust, by degrees render emigration unnecessary,

and thus realize the thought usually expressed in Sweden by the words »bring America to Sweden».

But for emigration, the increase of population would probably have continued in Sweden with an almost incessant progress. At any rate the *annual surplus* of births over deaths, during the periods mentioned below, was:

Period.	Numbers.	‰ of mean population.	Period.	Numbers.	‰ of mean population.
1816—40	27,173	9·66	1861—70	45,876	11·25
1841—50	34,772	10·51	1871—80	53,590	12·21
1851—60	40,414	11·10	1881—90	56,660	12·12

The degree in which emigration has affected this increase of population will be seen from following table:

Period.	Surplus of births over deaths.	Emigrants. Total.	Emigrants. % of surplus.
1851—60.....	404,141	16,900	4·2
1861—70.....	458,760	122,447	26·7
1871—80.....	535,897	150,269	28·0
1881—90.....	566,598	376,401	66·4

During the eighties, emigration swallowed up two thirds of the surplus of births over deaths. To some slight degree emigration is counteracted by immigration — a few thousands annually — chiefly by former emigrants returning to their native land.

As regards destination, the following table shows whither emigration was directed:

Period.	United States.	Other Countries.	Total.
1851—60	14,865	2,035	16,900
1861—70	88,731	33,716	122,447
1871—80	101,169	49,100	150,269
1881—90	324,285	52,116	376,401
Total	529,050	136,967	666,017

Of the 137,000 who have gone to other countries than the United States, 124,000 have simply moved to those countries that are our nearest neighbours, Norway, Denmark, Finland, Russia, and Germany. It has been found that of each 100 individuals emigrating to Norway 47 return, while 53 per cent of those going to Denmark, and 75 of every hundred settling in Germany also return to Sweden. From Finland and Russia still more immigrants come to Sweden than she sends them. Only 6 per cent of those Swedes return, who have emigrated to the United States.

The following table shows the age, sex, and total number of emigrants during the five and twenty years, from 1866 to 1890:

Age.	Males.	Females.	Total.
0—15	60,004	58,357	118,361
15—35	239,363	178,676	418,039
35 and over.....	50,163	42,738	92,901
Total	349,530	279,771	629,301

About two thirds, as we see, are of the ages between 15 and 35, and on eloser investigation this large group is subdivided in the following manner:

Age.	Males.	Females.	Total.
15—20	54,129	46,917	101,046
20—25	91,807	64,915	156,722
25—30	60,944	43,204	104,148
30—35	32,483	23,640	56,123
15—35	239,363	178,676	418,039

Of the 666,000 individuals who emigrated during the forty years 1851—1890 inclusive, 126,000 were married; 128,000 children under fifteen years of age; 241,000 bachelors; and 171,000 spinsters. The number of unmarried men is however assuredly under-estimated.

Even at a very low calculation, the Swedish population in the United States, — counting the children born thereof in America — must now be about 800,000 persons. Most of this population, as is well-known, is congregated in the States of Illinois, Minnesota, North and South Dakota, Iowa, Kansas, etc.

CONSTITUTION AND ADMINISTRATION.

Sweden is a constitutional monarchy; the Constitution now in force was given on June 6th, 1809, and the Regulation of the Diet on June 22nd, 1866.

All affairs of state shall be laid before the King in **Council of State**, and there despatched; of the ten members of the Council, seven shall be at the head of as many departments, viz: Justice, Foreign Affairs, War, Navy, Interior, Finance, and Ecclesiastics. The consent of both King and Diet is necessary for making a new law, but the Diet has sole right of imposing taxation and decides the Budget.

The **Diet** consists of two Chambers, called first and second, which in all questions have equal right and authority. Only as regards the Budget is the power of the Second Chamber somewhat more than that of the First, in consequence of questions on this subject — should the two Chambers arrive at different conclusions — being decided by renewed voting in common, when the Second Chamber has the advantage of being numerically superior (at present 228 to 148 in First Chamber). The Diet meets annually from January 15th to May 15th, while extraordinary diets may be convened by the King. The members of the Diet are elected for a stated period, those of the First Chamber for nine years,

those of the Second for three; the King has, however, the right of prescribing new elections before the expiration of either period.

The members of the *First Chamber* are elected by the Provincial Councils and by the Town-councils in towns of more than 25,000 inhabitants. Each province, or such large town, chooses one deputy for every 30,000 inhabitants. So as to be eligible, a man must be 35 years of age, be in possession of — and have possessed for at least three years previous to the election — ground property assessed at 80,000 crowns ($ 21,440) or have a taxable income of 4,000 crowns ($ 1,072). These members, at present 148 in number, receive no remuneration. The number of persons in all Sweden who are eligible to the First Chamber is about 10,000.

The members of the *Second Chamber* are elected, one member for each country district of jurisdiction (two members for a district of more than 40,000 inhabitants), and one for every 10,000 inhabitants of the towns, small towns being united to one constituency. For electoral franchise it is necessary to possess a communal vote; the possession of ground property worth at least 1,000 crowns ($ 268); or the lease for five years, or for the whole life, of landed property taxed as worth at least 6,000 crowns ($ 1,608); or an annual taxable income of 800 crowns ($ 214). The elections take place either directly or indirectly, when each voter has one vote. So as to be eligible it is requisite to be entitled to electoral franchise (consequently to reside in the constituency) and to be 25 years of age. The members of the Second Chamber receive for each Diet, lasting four months, the sum of 1,200 crowns ($ 322), besides travelling expenses. At present their number is 228. The entire number of persons entitled to vote in elections to the Second Chamber is at present about 300,000, or not quite one fourth of the number of men that are of age.

The Speakers, or presidents and vice-presidents of the Chambers, are appointed by the King from among the members of the Chambers. Questions, rejected in either Chamber, are dismissed, excepting only such as relate to grants, which in this case are decided by renewed voting in common. The Diet alone, by its chosen delegates, administers the Bank of the Realm and the National Debt Office, and appoints a Solicitor-general who shall watch over and, in case of delict, arraign the government officials and the judges.

The Swedish Diet, next to the English Parliament, is the oldest representative assembly in the world. Peasants have been admitted there as members for more than five hundred years. At the present time more than half of the members of the Second Chamber are peasants, which fact is indeed characteristic for the Scandinavian States.

For questions relating to Canon Law, not only the consent of the King and Diet, but also that of the **Synod** is necessary, which Synod meets every fifth year. The members thereof are 30 ecclesiastics and 30 delegates elected by laymen, the Archbishop being the chairman.

The **Administration of State** is conducted partly by Boards, the joint

members exercising right of decision in common, and partly by Committees, where the decision rests with the president alone. For local administrative purposes, the country is divided into 25 provinces (län), each having a governor, the town of Stockholm, which forms a government of itself, having a governor-general. The government officials are nominated by the Government, or by subordinate authorities. From a certain number of the higher posts the holder may be dismissed, but otherwise the officials cannot be cashiered without having been previously tried and sentenced. The position of Swedish government officials is therefore unusually free and independent.

The *income* and *expences* of the Swedish state run to about 26 to 27 million dollars annually. The sources of income are chiefly: customs 10 million dollars; excise on Swedish brandy 3 1/2 million; land-tax (recently abolished for times to come) 1 million; income from state railways (net) 1 3/4 million; domains 1 1/3 million; income and property tax 1 million dollars, etc. The expenses, according to Budget for 1893, are:

Royal Household	$ 354,000
Justice	1,061,000
Foreign Affairs	164,000
Army	6,483,000
Navy	2,319,000
Interior	1,899,000
Education, Ecclesiastical affairs	3,838,000
Finance	4,665,000
Pensions	1,189,000
National Debt	2,630,000
Diet	165,000
Construction of Railways	1,394,000
Sundries	165,000
Total	$ 26,326,000

The figures for the defence do not include the greater part of the expenses for the »Indelta» troops (see next page), the entire cost of the defence running to over 10 million dollars.

The *national debt* amounts to about 71 million dollars; but has simply been contracted for constructing the state railways. The *assets* of the Swedish State (woods, domains, railways, etc.) are calculated at 111 million dollars.

The Administration of Justice. Every town, as also every district of jurisdiction in the country, has its court of first instance, the total number at present being 207. Courts of appeal are the three High Courts in Stockholm, Jönköping and Kristianstad. The very highest instance is the Supreme Court, consisting of 16 members. In Sweden a jury is never impanelled except for matters concerning the liberty of the press; at the lower courts there are, however, always jurors chosen by the people. In Sweden judges cannot be deposed, unless duly tried and sentenced.

The Swedish Law differs from those of other European countries in its not being based on Roman (civil) law, but that it has sprung from the wants and customs of the people, in days long since past. The present collection of laws dates from 1734; though, in course of time, some changes have been made and many additions afferred, among which a new penal code of February 16th, 1864, is the most important.

The Administration of the Church. The National Church in Sweden is Lutheran, and all citizens are obliged to contribute to its maintenance. Nonconformists, however, are entitled to perfect freedom as regards religious observances, and all civil rights, with but rare exceptions, are entirely unaffected by faith professed. The highest authority of the Swedish Church is the King, and next in order to him come 12 bishops, of whom the bishop of Upsala ranks first, and is called Archbishop. Sweden is divided into about 2,500 Lutheran parishes, which themselves choose their clergy, but with some restrictions in favour of the Government and the diocese. The Synod has been mentioned above.

Self-government, which is very old in Sweden, attained its present form thanks to the Law of March 21st, 1862, by which the 2,500 communes of Sweden — or each town for itself and, as a rule, every parish in the country — each manages its own affairs; in the country and in small towns by meetings of all those entitled to vote (sometimes several thousand), and in the larger towns by chosen representatives, town-councillors In both cases a committee for carrying out resolutions passed is chosen by vote. The right of vote in communal matters belongs to about 40 per cent of the entire number of men of full age, and, under certain conditions, also to women. The voting, however, is not per capita but, with certain restrictions, according to sum paid in taxation, thus placing great power in the hands of the wealthier classes. The combined expenses of the communes run to close upon 18 million dollars a year, and their assets, at the close of 1890, to 68 million dollars, while their debts were 42 million dollars. The twenty-five provinces have also their representatives or *Provincial Councils*. Their combined budget is somewhat less than 1 million dollars, the assets being 3 million and liabilities not quite 1 million dollars.

ARMY AND NAVY.

The extraordinary Diet, convened in 1892, decided that there should be important changes in the somewhat antiquated **army** of Sweden, with a view to greatly increasing its defensive power. The new organization will, however, take a few years to complete.

In times of peace the Swedish army is 38,000 men, about a fourth being enlisted, but the larger part consisting of so-called »Indelta» troops, which are annually called to attend exercises, but, during the greater part of the year, farm the small crofts set apart for their use by the landowners. This military tenure

system, which makes a good and useful citizen of the soldier in times of peace, and a good warrior in war time (the famous soldiers of Charles XII were chiefly men of this stamp) is, however, rather expensive, and under the new organization just mentioned, will be chiefly confined to infantry, while the artillery and the greater part of the cavalry will consist of men that have enlisted. Including the enlisted soldiers that have already served their time but have not attained the age of 32 years, it is calculated that *in time of war* the Swedish standing army would consist of 52,000 men. Besides this, *Conscription* claims every male capable of military service between 21 and 32 years of age (about 300,000 men); the necessary training being imparted, in altogether 90 days, for the cavalry in the first year, and for the other conscripts during the first two years. The »*landstorm*», about 150,000 men, composed of militiamen between 32 and 40 years of age, is intended only for local defence. The chief *fortifications* of Sweden are Karlskrona, on the south coast; two fortresses outside Stockholm, viz Vaxholm and Oscar Fredriksborg; and, in the interior, Karlsborg, near Lake Vettern.

The navy consists of 3 first class iron-clads, 4 large and 9 smaller iron-clad monitors, 15 torpedo boats, 9 gunboats of the first class and 5 of the second, and about 20 other vessels, with altogether 150 guns, the crews numbering in all about 4,500 men, not including conscripts to the number of 8,500 men.

The entire cost of the defence of Sweden by land and sea runs to more than 10 million dollars a year.

EDUCATION.

Popular education is compulsory in Sweden and almost entirely free of charge. Out of 777,610 children of school-age, in 1891, there were but 26,574 not availing themselves of tuition, either on account of illness, physical defects or other causes. Besides these, 29,803 had already passed the standards of the National Schools, and for this reason were exempt from tuition. Of the remaining 721,233 children, 656,947 received instruction in the National Schools; 16,532 in private scholastic establishments; 13,470 in schools imparting secondary education, or technical schools, and 34,284 in their own homes, being in this case under the control of the School Board.

The National Schools are under the superintendence of the clerical heads of the diocese; the management of the schools being entrusted in every district (parish) to a board (chosen by the district) of which the rector is legitimate chairman. Including a number of children who are not really of school-age, there were 692,360 pupils at the National Schools, or 14·4 per cent the of entire population of the kingdom. The number of the schools was 10,702, and of teachers 13,797; of these 8,333 were women. The salary of the regular teachers is at least 160

dollars a year (after five years office 188 dollars) besides lodgings and fuel, together with fodder for a cow, and a small plot of land; in the towns the salaries are often far higher. All teachers, their widows, and children, are assured pensions. In many Swedish schools instruction embraces sloyd (see Department L) and gardening is almost universally taught. The fact of the grown population, almost without exception, being able to read and write, has already been mentioned. The expenses of the Swedish National Schools amount to more than 3,600,000 dollars per annum, the State granting 1,100,000 dollars the remainder being provided by the School Districts. There are 9 *training colleges* for the education of teachers, male and female.

The so-called **Peasant High Schools** are peculiar to Scandinavia, having originally been organized in Denmark; at these schools young men and women of the peasant class receive a higher education than that available in the National Schools. These High Schools — most of them having been founded by private enterprise, but at present receiving grants both from the State and Provincial Councils — are in Sweden 25 in number with altogether 927 pupils, 305 being women.

Secondary Instruction is imparted at about 70 scholastic establishments of which, however, but about 30 lead their pupils as far as the demands requisite for entering the universities. This instruction is in Sweden as good as gratis, since the fees paid by the pupils simply amount to about 8 or 10 dollars for each pupil, for which reason these schools are largely attended by the less well-to-do classes. The entire number of pupils in 1891 was 14,474. During the same year 650 pupils passed the prescribed examination for a right of admittance to the universities, 15 of them being women. The expenses of this secondary education amount to 1 million dollars a year.

University education is imparted at two complete national universities, Upsala and Lund, each with four »faculties» or departments, as also at two private High Schools recently founded in Stockholm and Gothenburg; this latter having a department for the humanities, while the former has departments for mathematics, natural science, and, in part, the humanities, and will very shortly start a department of law. There is also at Stockholm a Medical High School which is a State Institution. The number of teachers at these establishments amounts to about 300, and that of the students to about 3,000. There are many great names to point to in respect to scientific work in Sweden, more especially as regards natural science, Linné, Bergman, Scheele, Berzelius, Wahlenberg, Sven Nilsson, Fries, Ångström, Edlund, and many others.

As to Technical Instruction, the reader must be referred to the different articles under the special headings (Agriculture, Forestry, etc.) and Department L.

TRADES.

The Swedish *soil*, consisting of about 100 million acres of land, was in 1891 apportioned as follows:

	Hectares.	Acres.
Orchards and Market gardens	35,000	86,000
Arable land	3,309,000	8,173,000
Natural meadows	1,637,000	4,043,000
Wooded ground	18,178,000	44,900,000
Other ground	17,426,000	43,043,000
Total	40,585,000	100,245,000

The entire area of Sweden comprises therefore of soil for husbandry 12 per cent; woods close upon 45 per cent; and unreclaimed land 43 per cent. The soil fit for cultivation is deemed still larger in extent than the ground already under tillage.

The population of Sweden, on taking the census in years mentioned below, has been found to be classed under the chief groups of *callings* as:

	1870.	1880.	1890 (calculated).
Agriculture	2,994,000	3,079,000	2,935,000
Mining and Manufacture	615,000	810,000	1,050,000
Commerce and Transport	211,000	326,000	450,000
Army, navy, liberal professions	349,000	351,000	350,000
Total	4,169,000	4,566,000	4,785,000

Of the entire population of Sweden, more than 60 per cent gain their livelihood by agriculture, rather more than 20 per cent by mining and manufacture, and close upon 10 per cent by commerce and conveyancing.

The preceding figures plainly prove that Sweden is still chiefly an **agricultural** country; there being no less than close upon $1\frac{3}{4}$ acres of arable land per inhabitant, an unusually high figure for Europe. The Swedish soil is divided into about 330,000 parcels, 280,000 being farmed by the owners themselves, and but 50,000 by tenants. Most of the ground belongs to small landowners, even if there are, in certain provinces, a number of large estates. The Swedish peasant has always been free and independent, the feudal system and consequent serfdom for the agricultural labourer having never gained a footing in Sweden. Agriculture has made great progress, and the return yielded by the soil is very fair, for instance, wheat yields 20 to 22 bushels per acre, while the average for Western and Southern Europe is 17 bushels, and for the United States but 12 to 13 bushels. Of late years, however, in Sweden, as in most other European countries, the soil has not yielded sufficient food for the needs of the population, chiefly in consequence of the increase in consumption, and also because, owing to the increasing

importance of cattle-rearing, more stress has been laid on producing fodder than on growing cereals. The value of all the ground farmed in Sweden is computed at rather more than 720 million dollars. For further particulars concerning Swedish Agriculture the reader is referred to the report given in Department A.

Forestry and Lumbering must not be omitted among the most important trades of Sweden, nor the saw-mill industry connected therewith. Sweden in point of fact is the country that exports most wood in the world, and provides no less than 20 per cent of the entire supply of the Globe, or more than Canada, and almost twice as much as the United States. For further particulars, vide Department A.

The vast extent of natural meadows in Sweden (more than 4 million acres) proves that our country has a future in **Cattle-rearing**. This branch of industry, which has long been neglected, has of late years been cultivated with great zeal, and Sweden already has an important surplus of live stock and butter for exportation. Meat, however, is still imported to a great extent, and the same holds good, though on a decreasing scale, as regards bacon. The rearing of sheep has decreased and there is a large import of wool. The stock of cattle, in 1891, when compared to the general state of things in Europe, was as follows:

	Numbers.	Per 1,000 inhabitants.	
		Sweden.	Europe.
Horses	489,000	102	108
Horned Cattle	2,420,000	504	300
Sheep	1,345,000	280	550
Pigs	655,000	136	137
Goats	79,000	17	54

It will be noticed that Sweden has a very large number of horned cattle in comparison to other European countries, but the quality of the stock, though good in some parts of the country, allows of great improvement in certain provinces. For further particulars on this subject vide, Department C.

The Swedish **Fisheries** are described in Department D.

Sweden possesses vast quantities of ore, and **Mining** has, for several centuries, been one of the chief occupations of her people. In days of yore the copper and silver mines were the most productive, but nowadays iron is the main-stay of the Swedish mining interest. Swedish iron, as is well-known, is deemed the best in the world. In consequence of its extraordinary quality, it fetches the highest prices in the marts of the world, but the comparatively large cost of production, owing to long freightage and want of coal, has thrown many obstacles in the path of the Swedish iron-works, during the present untiring competition, and the progress made by the Swedish iron trade — as regards quantity — has been greatly impeded by this fact. During the past sixty years the production of pig-iron in Sweden has risen from 100,000 tons to about 500,000, but the share Sweden takes in the production of pig-iron for the whole world has decreased

to a considerable degree; from more than 7 per cent in 1830 to but 2 per cent at the present time. The figures as to the production of steel (200,000 tons) are far more favourable, great progress having been made of late years, and it must be remembered that Sweden has taken an important part in the improvement of the celebrated invention of Bessemer. Of late years no slight export of iron-ore has taken place, the ore coming both from Central Sweden, and from the famous Gellivara, in Lapland, a true mountain of iron, which is considered capable of supplying the present demands of the whole world, as regards iron-ore, for centuries. As it is but a few years since a railroad has been built between Gellivara and the coast, it is as yet too early to express any opinion concerning the development which may attend this Lapland iron trade. Besides iron, Sweden produces copper (700 tons a year) and silver (6,000 kilog.) and in the southernmost province, Malmöhus, about 200,000 tons of coal; while the raising of zinc ore is of no slight importance. As regards useful minerals there is a good supply of many kinds, but Sweden totally lacks the indispensable article salt. Vide Department E.

Industry. It is only in a few branches that our industries can supply our needs, and the import of industrial goods to Sweden is, on the whole, larger than her export. There are, however, many branches of industry that show a high figure for exports, and, taking it all in all, the Swedish industries have made great progress during the past decades, favoured as they are by the great wealth of natural products of our country, and the general aptitude of the population as regards industrial labour, more especially in respect to mechanics — it being simply necessary as a proof thereof to mention the many great inventors Sweden can claim as her sons, and, among others, first of all John Ericson. The progress of industry in Sweden is greatly hampered by her small supply of coal, owing to which deficiency the necessary »daily bread» of industry must be purchased largely from foreign countries. As, however, the use of electricity becomes more general, very favourable prospects open to Sweden as regards industrial pursuits, since in her innumerable waterfalls, Sweden has an extremely rich supply of cheap motive power.

According to the investigations carried on by the Workmen's Insurance Committee, it is computed that the purely manufacturing industries in 1885 gave employment to 123,000 workmen, without including those employed in mining and metallurgical pursuits; in 1893 their number may be reckoned as at least 150,000. In 1885 the branches employing greatest number of hands were:

	Workmen.		Workmen.
Lumbering and Saw-Mills ...	18,088	Stone, Pottery, and Glass ...	12,136
Building	17,027	Chemico-technical	8,855
Machinery	16,998	Paper	5,135
Nutrition	15,151	Various other branches..... .	14,281
Textile.....	15,078	Total	122,749

According to later statements there were employed in 1890, at Mechanical

Works and Foundries 15,804 hands, at Brickfields and Tileries 5,509, at Match Manufactories 5,227, at Breweries 3,959 hands, etc.

The number of *factories* may be estimated as about 6,000. From 3,250 of them reports have been obtained as to value of the manufacture, and in 1890, it was estimated at more than 72 million dollars. This figure, however, besides other omissions, does not include the whole Lumbering and Saw-mill industry which alone exports goods to a value of 30 million dollars a year. Concerning the development of the larger industries in Sweden, the following comparison between Germany and Sweden may be cited, which comparison was made by the aforementioned Swedish Committee sitting on Workmen's Insurance. The entire number of establishments devoted to manufacturing in 1885 employed:

	In Sweden.	In the German Empire.
Less than 10 hands	72·84 %	73·91 %
10—49 »	18·46 »	17·71 »
50—199 »	6·88 »	6·60 »
200—999 »	1·76 »	1·66 »
1,000 or more »	0·06 »	0·12 »
Total	100 %	100 %

Thus, relatively speaking, the number of large establishments in Sweden is pretty considerable.

The most important export industries are the timber trade — in which respect, as already stated, Sweden occupies the very foremost rank of all countries in the world — the match and paper industries; the manufacture of machinery, though in this latter branch much is imported; the important iron and steel trades, etc. Concerning each of these different branches, as also a number of the others, further details will be found in the specific descriptions that will ensue.

The *handicrafts*, as in other countries, have had a hard struggle in competing with mass-manufacture. The entire number of handicraftsmen and their artizans, in 1890, was stated as being about 56,000. One kind of occupation that has from days of yore been of great importance to Sweden is her Domestic Industry, which has, however, been declining for some time, and only of late years has again been called into play, mostly thanks to the efforts of private associations which have laid great stress on retaining and developing, as far as possible, national patterns. What has doubtless been of great importance for the revival of domestic industry, is the introduction of sloyd as a subject of instruction in the National Schools, in which respect, as is well known, Sweden has been the pioneer of other nations, and concerning which subject a detailed account may be read in Department L.

The laws for the *Protection of Workmen*, which have been the subject of such eager discussion of late years, will be found stated in Department L. In connection with this matter, it may be mentioned that according to the very latest investigations, the average day's work in Swedish industrial pursuits is 10 hours and three

quarters, and that in 1884 there were in Sweden more than 1,000 self-supporting sick-relief and funeral funds with altogether close upon 140,000 members, and a capital of nearly one million dollars.

Commerce. The *inland* trade of Sweden is, on account of the variety of the produce of its different provinces, very large, and is nowadays favored by excellent means of communication. Notwithstanding the isolated and northerly situation of the country, the *foreign* trade is also considerable, if estimated relatively to the population. The commercial value of the foreign trade, imports and exports together, amounts to $ 39 in yearly average for each inhabitant of Sweden, which is about as much as in France. The development of the trade with foreign countries, in yearly average, will be seen from the following table:

Period.	Import.	Export.
1841—50	$ 8,790,000	$ 9,840,000
1851—60	18,890,000	18,870,000
1861—70	31,360,000	29,480,000
1871—80	68,880,000	55,480,000
1881—90	87,640,000	69,140,000
1891	99,080,000	86,700,000

The figures of the last year thus show, in round numbers, an import of 100 million dollars and an export of 87 millions.

In the year 1891 the returns were distributed over the following main groups of merchandise, thus:

	Import.	Export.
Live Stock	$ 254,000	$ 1,956,000
Animal Food	4,272,000	14,664,000
Grain and its products	8,886,000	5,848,000
Colonial produce	13,320,000	338,000
Fruits and Garden produce	1,255,000	86,000
Spirituous and other Liquors	2,887,000	685,000
Raw materials for Spinning	6,572,000	34,000
Yarn, Thread, etc.	2,742,000	286,000
Manufactures of Spun materials	15,489,000	2,234,006
Hair, Feathers, Hides etc.	5,214,000	648,000
Manufactures of d:o	1,109,000	165,000
Tallow, Oil, Tar, Gum etc.	4,317,000	406,000
Manufactures of d:o	694,000	209,000
Wood (not worked, sawn or cut)	528,000	29,849,000
Wood (worked)	738,000	6,373,000
Colours and Colouring matters	1,025,000	88,000
Various vegetable matters	2,987,000	193,000
Paper and articles made of paper	1,648,000	6,903,000
Other articles made from veget. matters	125,000	97,000
Minerals, raw materials	11,017,000	1,582,000
Mineral Products	990,000	2,091,000

	Import.	Export.
Metals	2,347,000	8,828,000
Metal goods	4,089,000	1,302,000
Ships, Machinery, Instruments etc.	5,284,000	1,191,000
Money	248,000	53,000
Other articles	1,042,000	588,000
Total	$ 99,079,000	$ 86,697,000

The most important articles of import are, consequently, materials for spinning (principally cotton and wool), colonial produce, minerals (coal and salt) and diverse industrial products. The export, again, chiefly consists of timber products, the total value of this item amounting to more than 40 per cent of the entire value of export; further of butter, cattle, metals, etc.

The interchange of commodities in 1891 was principally with the following countries:

	Import.	Export.
England	$ 26,440,000	$ 39,231,000
Germany	32,116,000	10,151,000
Denmark	11,958,000	10,021,000
Norway	8,995,000	4,671,000
Russia and Finland	7,321,000	2,878,000
France	2,427,000	9,220,000
Other countries	9,822,000	10,525,000
Total	$ 99,079,000	$ 86,697,000

The direct trade between Sweden and the United States of America was, in the above year, according to Swedish statistics, valued at $3^1/_2$ million dollars, of which the exports were but $^1/_5$ million. With closer examination into the commercial interchange between Sweden and America through intermediate hands, the actual trade is found to be much larger. Mr Thomas, Minister for the United States in Sweden, calculates for 1889, when the direct import from the United States to Sweden was estimated at but $1^1/_2$ million dollars, that the *actual import* to Sweden of American goods amounted to fully 8 millions, distributed as follows:

Cotton	$ 1,795,000	Indian Corn	$ 231,000
Petroleum	1,720,000	Watches and parts thereof	75,000
Sole-leather (butts)	1,247,000	Other articles	1,998,000
Pork	751,000	Total	$ 8,055,000
Wheat	238,000		

The export from Sweden to the United States is similarly calculated by Mr Thomas to have had a value, the same year, of 2,760,000 dollars, whilst the statistics regarding the direct export give but 388,000 dollars. The principal part of this export, or more than 2,000,000 dollars, consisted of iron goods; further, wood-pulp to the sum of 280,000 dollars, matches valued at 85,000 dollars etc.

Many articles of import are liable to *duty* on entering Sweden. Formerly also certain articles of export were dutiable. The annual average of import duties was:

Period.	Dollars.	% of the whole value of import.
1841—50	1,652,000	18·8 %
1851—60	2,800,000	14·8 »
1861—70	3,680,000	11·7 »
1871—80	6,349,000	9·2 »
1881—90	9,104,000	10·4 »
1891	9,985,000	10·1 »

Gothenburg and Stockholm are Sweden's two principal commercial towns. The foreign trade of each in 1891 will be seen from the following figures.

	Import.	Export.
Gothenburg	$ 27,680,000	$ 26,356,000
Stockholm	28,478,000	6,134,000
Other towns	42,921,000	54,207,000
Total	$ 99,079,000	$ 86,697,000

Of the total imports of the country almost 60 % thus falls on Gothenburg and Stockholm, but of the exports not quite 40 %, which is due to the circumstance, that the principal article of Swedish export, timber, is chiefly sent out from Norrland ports, Sundsvall, Hernösand, Söderhamn, Gefle and others.

Shipping. In consequence of Sweden's geographical position almost all articles of interchange with foreign lands are conveyed by sea and only about 3 per cent cross her frontiers. Calculated according to value, of the entire import 52 per cent is carried by Swedish vessels, 5 by Norwegian, 39 by other vessels and 4 per cent by land; while of the export, 42 per cent falls to Swedish vessels, 7 to Norwegian, 49 to other vessels and 2 per cent cross the frontiers. The Swedish *Merchant Service*, at the close of 1891, numbered 2,979 sailing vessels of 377,667 tons and 1,181 steamers of 152,493 tons, or altogether 4,160 vessels of 530,160 tons. The entire number of arrivals and departures from and to *foreign ports* was 60,941 of 11,285,355 tons; of which 26,508 were steamers of 8,137,775 tons. The gross *freightage* received by Swedish vessels for foreign shipping was not quite 10 million dollars. The *home and inland navigation* is very lively in Sweden. The number of arrivals to and departures from home ports in 1891 was 177,358 of 16,887,295 tons; of these vessels 120,036 were steamers of 14,051,354 tons and only 57,322 sailing vessels of 2,835,942 tons.

The **National Wealth** of Sweden has been computed by Professor P. Fahlbeck of Lund University as being:

Landed Estate	$ 724,000,000
Woods and Forests not included in landed estate	11,500,000
Mines and other important Finds	11,600,000
Fish and Fisheries not included in landed estate	9,800,000

Other Estate than landed	390,900,000
Means of Communication	118,500,000
Merchant Service	21,300,000
Live Farm Stock	118,000,000
Dead » »	37,300,000
Machinery not belonging to other estate; boats and fishing tackle	21,400,000
Stocks and Stores	107,000,000
Movables and personal property	175,000,000
Coinage and Bullion	11,700,000
Foreign Claims	13,000,000
Total	$ 1,771,000,000
Foreign Debts	178,000,000
Balance	$ 1,593,000,000

This is about 340 dollars per inhabitant, and concerning these figures it may be observed that those for woods, forests and mines appear to be rated very low, even if a considerable part of their value is entered under the rubric landed estate.

COINAGE, BANKING AND INSURANCE.

Coinage. Sweden formerly based her system of coinage on silver, but twenty years ago the gold standard was adopted. The statute of May 30th 1873 declares that gold alone shall be the standard of value in Sweden, that the monetary unit shall be called Krona (crown) containing 100 öre, and that a 10 crown gold piece shall weigh 4·4803 grams and contain 9 parts of pure gold and one of copper alloy, consequently 4·032258 grams of pure gold. For small coins both silver and bronze is used. Two and one crown pieces, as well as smaller denominations, are coined in silver, (the alloy is 2 parts copper to 8 parts silver), a crown piece weighing 7·5 grams and containing 6 grams pure silver. A Swedish Krona (plural kronor) is equivalent to 26·8 cents or $ 0·268, while a dollar is Kr. 3·73. In conformity to a decision of a convention held on Dec. 18th 1872 and later agreements, Sweden, Norway, and Denmark now have a common system of gold coinage. Bank notes, however, are also used, being issued in Sweden both by the Bank of the Realm and by 26 private banks, of which more anon. Perfect trust is placed in Sweden in these bank notes and they have almost entirely ousted gold from circulation, the gold being instead stored in the bullion rooms of the banks. The smallest value of bank notes now issued is 5 crowns ($ 1·34) for notes of Bank of the Realm and 10 crowns ($ 2·68) for notes issued by the private banks.

Banking. *The Bank of the Realm* is the principal and oldest bank in Sweden, having held a charter since 1668, being then a continuance of one established in 1656 by J. Palmstruch, the first in the world from which notes were issued. The Bank of the Realm is utterly and entirely under the control of the Diet, not that of the Government, and is managed by commissioners

appointed by the Diet. The Chief Office is in Stockholm and there are 10 branch-offices.

Private Banks are of two kinds, viz:

1) Private Banks that issue notes, and to which a charter has been granted for ten years, all the shareholders (at least 30 in number) being solidarily liable for all the obligations of the company. Sleeping partners are allowed, whose liability is limited by the full value of shares held, but only to the extent of, at most, half the amount subscribed by the solidarily responsible shareholders. The capital of each private bank shall amount to at least one million crowns ($ 268,000). Among these banks that of Skåne, the oldest, was granted a charter for the first time in 1830. Their number is at present 26.

2) Joint Stock Banking Companies not issuing notes, 8 in number, of which the first was established in 1863, are based on the enactment of October 6th 1848 anent Joint Stock Companies, the shareholders being liable only in proportion to the stock they hold. In addition to these there are several other loan institutions, and the so called »people's banks».

Most of the Private Banks have branch offices in various parts of the country, which greatly increases the real number of banking establishments.

The assets (active or passive) of above-mentioned banks were on January 1st 1893:

The Bank of the Realm	$ 36,240,000
Private Banks issuing notes	127,377,000
Joint Stock Banks	60,271,000
Total	$ 223,888,000

The notes in circulation on the same date were 11·8 million dollars of those of the Bank of the Realm, and of the private banks 15·5 millions.

Savings-banks. The number of savings-banks in Sweden in 1890 was 388 with 529 branch-offices, the number of depositors at the end of the year being 1,089,421 or close upon 23 per each hundred inhabitants of the whole kingdom. Besides these there were 237,060 depositors in the Post Office Savings-bank established 1884, which, as a general rule, receives small sums. The amount of the deposits remaining in the real Savings-banks was more than 75 million dollars and in the Post Office Savings-bank 3 millions and a half, or altogether close upon 80 million dollars.

Loan offices for special purposes exist in great number, among which may be mentioned the Public Mortgage Bank, connected with 10 Mortgage Companies, their business being to change the floating debts on land to consolidated debts; the common amortization-debt is now about 85 million dollars; then there is a Public Mortgage Fund for the Towns of Sweden, another for the Iron Masters Association, and several others.

Insurance has gained much ground of past years. In 1891 there were 7 *Life Insurance* Companies in existence, and also 4 Mutual Companies; the number

of persons insured being 56,275 and the total sum insured by them more than 82 million dollars. Besides this, there were 2,451 persons insured in foreign companies, carrying on operations in Sweden, for not quite 5 million dollars. The assets of the Swedish companies in 1891 amounted to 30 million dollars, the premiums paid the same year being 2,850,000 and renewed premiums 235,000 dollars, while the amount paid out on insurance policies, after deducting those renewed, was 690,000 dollars, and in annuities 164,000 dollars. More than 200,000 dollars of the profits of the companies were distributed as bonuses to the policy-holders. *Accident Insurance* Companies are six in number with close upon 100,000 policy-holders and amount assured 74 million dollars; besides which there are 4,500 persons insured in foreign companies for about 8½ million dollars. *Fire-Insurance Offices* are very numerous, and many foreign insurance companies are also active in this country. In the year 1891, it is estimated that Swedish property was insured in Swedish companies for an amount of 1,360 million dollars and in foreign companies for 65 millions. In respect to *other branches of insurance*, it may be mentioned that in 1891 there were in Sweden 18 Swedish Marine Insurance Companies (of which 8 Mutual) with a combined gross insurance amounting to 182 million dollars, and a net insurance sum of 112 millions; moreover there are numerous live stock insurance companies with amount insured in 1885 of at least 12 million dollars, six companies undertaking to insure against damage by hail with amount insured close upon 6 million dollars, etc.

MEANS OF COMMUNICATION.

Sweden now, both by land and sea, is provided with excellent means of communication. The *high roads* are altogether close upon 37,000 miles in length, 22,000 miles thereof being provided with post-houses. The *railroads* are now the chief means of communication of Sweden. Although they were opened somewhat late here — first in 1855 — Sweden, in comparison to her population, now owns more railways than any other land in Europe; while in respect to its area the southernmost quarter of the country is nearly as well furnished with railways as France for instance. The entire length of the Swedish railroads is close upon 9,000 kilom. or 5,500 miles; rather more than a third part belonging to the State. The gross income amounts to more than 13 million dollars a year. In Sweden we find the only railway in the world which passes the Polar circle i. e. that of the State line Luleå—Gellivara. For further particulars concerning the Swedish railways, the reader is referred to Department G.

Communication *by sea* plays an important part in this country. Along the entire extensive coast (1,600 miles) a lively traffic is kept up, as also on the great lakes and the numerous canals. The Göta and Dalsland Canals in Southern Sweden and Strömsholm Canal in Central Sweden are very favourite routes for tourists.

The *Post-Office,* which, as early as 1636, was made a government department in Sweden, annually transmits more than 130 million letters and parcels. The post-offices number more than 2,000. Sweden has more than 8,800 kilom. or 5,480 miles of *telegraph* lines, those of the railways not being included, the length of wires being altogether 23,500 kilom. or 14,600 miles. The telegraph has not reached a very high state of development in Sweden (the number of telegrams not being fully 2 million a year for close upon 5 million inhabitants) but so much the more progress has the *telephone* made. This novel means of communication has been eagerly embraced by Sweden to an extent, which, relatively speaking, far surpasses that of any other country in Europe. The total length of the connections was, a year or two ago, more than 60,000 kilom. or close upon 38,000 miles, and the number of the apparatus was 25,000. An enormous amount of telephoning goes on, especially in Stockholm, where there are more than 8,000 apparatus in use for a population of 250,000 people, so on an average there is one apparatus to every thirty inhabitants. Even in America, the birthplace of the telephone, we shall scarcely find a companion picture to this fact. Further particulars will be found in Department J.

WEIGHTS AND MEASURES.

In 1876 the *Metric System* was adopted in Sweden and has been compulsory since January 1st 1889. In reducing metric weights and measures to American in this work, the following reductions have been used:

1 metre	= 3·28 feet.	1 litre	= 0·264 gallon.
1 kilometre	= 0·621 statute mile.	1 hectolitre	= 2·84 bushels.
1 hectare	= 2·47 acres.	1 kilogram	= 2·205 lbs.
1 sq. kilometre	= 0·386 sq. mile.	1 metric ton	= 19·7 cwts.

Vessels are in Sweden measured by Moorsom's system, the so-called German rule as to reduction for steamers being applied.

It has already been mentioned that the unit of coinage is a Crown = 0·268 dollar (1 dollar = 3·73 Crowns).

After this general review we shall proceed to a statistical account of the different branches arranged by Departments and Groups according to the Catalogue of the World's Columbian Exposition.

DEPARTMENT A.

AGRICULTURE, FOOD AND ITS ACCESSORIES. FORESTRY AND FOREST PRODUCTS. MACHINERY AND APPLIANCES.

Cereals, Fodder Plants, Roots, Sugar, etc.

Agriculture is still the most important industry of Sweden, it being calculated that it supports about 3 million inhabitants, i. e. more than 60 per cent of the entire population of the kingdom. The area used for husbandry in 1891 was:

	Hectares.	Acres.
Orchards and Market-gardens	35,000	86,000
Arable land	3,309,000	8,173,000
Natural meadows	1,637,000	4,043,000
Total	4,981,000	12,302,000

Thus, out of the whole area of the kingdom (100 mill. acres dry land) a little more than 12 per cent are devoted to agriculture, but so unequally is this soil distributed, that in Malmöhus, the most southern province, no less than 77 per cent consists of fields and meadows, and of the eighteen southern provinces on an average 30 per cent of the land is under cultivation, while the remaining seven extensive provinces lying farthest north reach but 4 per cent.

In most of the provinces of Sweden there are wide tracts that are cultivable, the combined extent of which is considered as fully as large as the land at present cultivated. As a matter of fact during the present century much land has been reclaimed, and as a proof of this it may be added that the extent of arable land has increased from 1^{3}_{4} million acres to above 8 million, or more than quadrupled, during the past 85 years.

The Swedish soil generally gives a good return, as wheat for instance yields 20 to 22 bushels an acre, while the average crop in Europe (Russia excepted) is only 17 bushels and 12 to 13 in the United States. Even in the more northern

parts of Sweden the soil is fairly good, although farming is rendered difficult by the night frosts that occur early in autumn.

As a general rule, Swedish soil is carefully cultivated, although great progress may yet be made in this respect. Large tracts are annually drained, the cattle — the management of which has reached a high state of perfection — supply abundant manure, and where such fertilization is necessary, artificial manure is largely used. It is however but slowly that agriculture has developed to what it now is, and if this gradual development be traced, it will be found that the axe and fire were the first simple tools of our forefathers. The axe was used to fell the trees, and remove the bushes and, and when this was accomplished, fire was allowed to do the rest. However, the soil thus reclaimed by this simple burning method could not, for any length of time, yield even the very scanty crops our ancestors were probably contented with, so it became necessary to work the ground with a mattock and remove the stones, so that it might bear new crops, this method being followed by the practice of sowing successive crops until the land was utterly exhausted, when it was deserted and a new field was worked and treated in the same manner. This practice is still prevalent in some parts of our northern provinces, chiefly in the most sparsely populated districts.

As, however, this way of cultivating the soil did not allow of any winter crops being sown, and impoverished the ground so that the returns became less year by year, it was found that the land needed a »rest» so as to gather new strength, so this method was abandoned for one in which half the land was left fallow and the other half was sown, being generally pretty equally divided as regards winter and spring corn, a system still very general among small farmers, in certain provinces of Sweden.

But knowledge was gained by experience and it was found that different plants made different requirements on the soil, so that if it were wrong to plant winter corn after a crop of that grain had been reaped, there was nothing to prevent spring-corn following spring-corn for at least a couple of years, while, if after this the field were allowed to produce grass, pulse, or root-crops, many years might be allowed to pass without giving the soil the »rest» of lying fallow. From this knowledge there developed by degrees the different rotations of crops, which so long as grain only is planted must be deemed very bad for the soil, this being specially the case as regards »four or five fallowing», when the field lies fallow, then winter corn, and two or three spring corn crops are borne. This method is, however, fast disappearing and wherever the soil is of comparatively high value, alternate husbandry is prevalent, when, as it need scarcely be explained, green crops such as clover, grass, or even root-crops alternate with grain-crops.

Agricultural Holdings. The farms of Sweden are divided into about 330,000 agricultural holdings, only about 50,000 of them being let on lease, while 280,000 belong to the farmers themselves. The number of farms and their area will be seen from the following table:

	Farmed by owner.	Let on lease.
Arable land up to 5 acres*	64,000	11,000
» » from 5 to 50 acres	190,000	29,000
» » » 50 to 250 acres	24,000	9,000
» » more than 250 acres	2,000	1,000
Total	280,000	50,000

In addition to these, there are 165,000 cottiers holding small portions of land directly from the proprietor in return for their service on set days, this being a very ancient way of remunerating agricultural labourers in Sweden.

Swedish agriculture may be said to be characterized by each farmer cultivating his own property, though as a general rule the holdings are small, even if there are a goodly number of large estates in certain provinces.

Import and Export. In times gone by — for instance during the seventeenth century and also during a few decades of the present — Sweden exported corn, but of late years instead of exporting she is forced to import, and the grain imported, consisting chiefly of rye and wheat, as regards value exceeds the export, which is chiefly of oats. The explanation of this fact is to be found in the growing demand of improved bread stuffs for home use and also in the increased use of grain for feeding cattle. The annual value of the import and export of grain and bread (the latter insignificant) has been:

Years.	Import.	Export.	Difference.
1871—75	$ 5,356,000	$ 9,870,000	+ 4,514,000
1876—80	8,749,000	10,537,000	+ 1,788,000
1881—85	11,271,000	7,806,000	— 3,465,000
1886—90	8,005,000	4,979,000	— 3,026,000
1891	8,886,000	5,848,000	— 3,038,000

During the last few years, in consequence of duty being laid on corn and flour in 1888, the import of flour has greatly decreased. For further details the articles concerning the different kinds of grain must be perused.

The **cultivated soil** was in 1890 distributed as follows:

	Hectares.	Acres.
Orchards and Market-gardens	34,557	85,356
Wheat	70,574	174,318
Rye	390,327	964,108
Barley	221,024	545,929
Oats	800,943	1,978,329
Meslin	105,336	260,180
Pulse	54,398	134,363
Esculent Roots	180,798	446,571

* Strictly speaking under 2 hectares, from 2 to 20, 20 to 100 and above 100 hectares.

	Hectares.	Acres.
Flax and Hemp	6,301	15,563
Fodder Plants	1,029,375	2,542,556
Other crops	1,360	3,359
Fallow	410,581	1,014,136
Total	3,305,574	8,164,768

To this must be added the natural meadows extending about 1^{2}_{3} mill. hectares (4 mill. acres).

Wheat is cultivated on a total area of 70,000 hectares (175,000 acres) exclusively in the southern and central provinces of Sweden. The returns are, as already stated, very good, on an average 20 to 22 bushels per acre, and the weight about 78 kilog. per hectolitre (60 lbs per bushel). The average yield per annum has been:

Years.	Metric Tons.	Bushels.	Bushels per inhab.
1811—20	20,000	730,000	0·30
1851—60	62,000	2,270,000	0·62
1861—70	70,000	2,560,000	0·63
1871—80	90,000	3,290,000	0·75
1881—90	100,000	3,660,000	0·78
1892	125,000	4,575,000	0·95

It is only recently that the superior kinds, Squarehead, Svalöfs English wheat, etc. have been employed in Sweden. These varieties have been found scarcely capable of standing the long springs, with accompanying chilly nights and hot sunny days, that occur north of Skåne.

The home consumption of wheat is annually 38 kilog. per inhabitant (1^{2}_{5} bushels), or at present state of population (4,800,000) in round numbers 6^{3}_{4} million bushels. To this must be added half a million bushels for sowing, making in all above 7 million bushels. The home supply consequently meets but little more than half of the demand, Germany, Denmark and Russia mostly supplying the rest, though indirectly much wheat comes from America.

Oats. At present of all grain grown in Sweden, oats are most extensively cultivated viz on 800,000 hectares (nearly 2 mill. acres). The crops in past and present years were per annum:

Years.	Metric Tons.	Bushels.	Bushels per inhab.
1811—20	130,000	7,900,000	3·2
1851—60	345,000	20,900,000	5·7
1861—70	483,000	29,200,000	7·2
1871—80	748,000	45,300,000	10·3
1881—90	959,000	58,000,000	12·4
1892	1,197,000	72,400,000	15·0

During the past 70 or 80 years the cultivation of oats has, as we see, been more than octupled. The principal centres of the cultivation of oats are the

west provinces of Central and Southern Sweden. In the central and northern parts of the country Black Oats are more general, while in the southern provinces White Oats are chiefly raised, this sort — as a very yielding and for Sweden most suitable variety has been found in the Probsteier oat — is rapidly gaining ground in Central Sweden, particularly on the plains. The produce per acre varies greatly, being on an average 30 to 32 bushels, but may rise to more than 50 bushels. The average weight of Swedish oats is about 37 lbs per bushel.

At one time the export of oats was one of the most important items of Swedish trade, but of late years it has decreased, owing to the increased consumption at home. Besides 11 million bushels for sowing, about 40 million bushels are annually used by Sweden, chiefly for cattle-rearing. The export, which during certain years was close upon 20 million bushels, now seldom exceeds half this amount, the greater part going to England.

Rye. High up in the most northern provinces of Sweden rye is grown, in favourable localities even close to the Polar Circle, though this is exceptional, as the real limit towards the north is considered to be 61°. As a rule so-called winter rye is cultivated, being sown in autumn, green during the winter, and earing the following spring. The spring-rye, which is not so generally cultivated, is annual, has smaller ears, being sown in spring and reaped at the close of the summer. Of these two kinds of rye the annual crops have, on an average, been:

Years.	Metric Tons.	Bushels.	Bushels per inhab.
1811—20	225,000	8,900,000	3·6
1851—60	455,000	18,000,000	4·9
1861—70	444,000	17,500,000	4·3
1871—80	489,000	19,300,000	4·4
1881—90	528,000	20,850,000	4·5
1892	604,000	23,850,000	5·0

In 1890 an area of 390,000 hectares (965,000 acres) was sown with rye. In Sweden the rye sown in autumn yields on an average 20 to 22 bushels per acre and weighs 56 lbs per bushel.

There is sown annually about 3 million bushels, while the consumption reaches 125 kilog. or nearly 5 bushels per inhabitant, in all about 27 million bushels, from which we see that ordinarily about one fourth of the demand, or about 6 million bushels, must be imported. The greater part of this import comes unground from Russia, though about two hundred thousand barrels of meal are imported, mostly from Germany.

Barley. Of all cereals, barley is that which is cultivated farthest north, reaching in Sweden to 68° 30′ N. and of the different varieties, the six-rowed is chiefly grown in the more northern provinces, while in those lying more to the south the two-rowed varieties, e. g. Chevalier, Printice and Feather barley, are cultivated. The barley crop has on an average annually been:

Years.	Metric Tons.	Bushels.	Bushels per inhab.
1811—20	220,000	9,900,000	4·0
1851—60	308,000	13,900,000	3·8
1861—70	293,000	13,200,000	3·2
1871—80	338,000	15,300,000	3·5
1881—90	340,000	15,350,000	3·3
1892	319,000	14,400,000	3·0

The cultivation of barley has made no progress as regards quantity during the last few decades, though it has become more lucrative, since good malting-barley is one of the articles now greatly prized by brewers. The barley-sown area is at present abont 220,000 hectares (550,000 acres) and the return reaches 27 bushels per acre. The weight per bushel averages about 50 lbs, in Norrland being only 44 lbs but in Gotland and Öland — the barley of these islands being far-famed — it averages 53 lbs and has risen to 60 lbs.

Rather more than 2 million bushels of barley are annually sown, besides which the home consumption may be calculated as from 12 to 13 million bushels (60 kilog. or rather more than $2^1/_2$ bushels per inhabitant); consequently there is generally a slight surplus for export, which is mostly sent to England.

Flour mills. There are no other direct reports concerning the extent of this industry but those forwarded to the Workmen's Insurance Committee of 1885 by close upon 2,000 employers in this branch of trade, most of them, however, employing but a small number of workmen, so that the entire operative force did not come up to 5,000 hands. Several large steam flour-mills have, however, commenced operations during the last decades, e. g. two in Stockholm, one in Upsala, etc. On the whole, the flour-mill industry has made great progress since 1888, when a pretty high import duty was laid on foreign flour. The decrease this import shows of late years, will be seen from following figures, when, concerning *wheat* first of all, we find per annum:

Years.	Import.	Export.	Import.	Export.	Surpl. of imp.
	Metric Tons.		Barrels.	Barrels.	Barrels.
1866—70	11,245	513	126,000	6,000	120,000
1871—75	15,731	2,419	176,000	27,000	149,000
1876—80	29,259	2,382	328,000	27,000	301,000
1881—85	30,739	5,212	344,000	58,000	286,000
1886—90	26,042	3,626	292,000	41,000	251,000
1889	20,466	2,059	229,000	23,000	206,000
1890	15,409	2,533	173,000	28,000	145,000
1891	15,569	1,543	174,000	17,000	157,000

For *rye-flour* the corresponding figures are:

Years.	Import.	Export.	Import.	Export.	Surpl. of imp.
	Metric Tons.		Barrels.	Barrels.	Barrels.
1866—70	24,453	198	274,000	2,000	272,000
1871—75	27,914	642	313,000	7,000	306,000

Years.	Import.	Export.	Import.	Export.	Surpl. of imp.
	Metric Tons.		Barrels.	Barrels.	Barrels.
1876—80.....	35,806	844	401,006	9,000	392,000
1881—85.....	20,508	2,462	230,000	28,000	202,000
1886—90.....	23,748	886	266,000	10,000	256,000
1889.....	16,393	503	184,000	6,000	178,000
1890.....	12,944	289	145,000	3,000	142,000
1891.....	10,158	131	114,000	1,500	112,000

Other Seedlings. These occur in the form of meslin and pulse and to a very small extent as rape and buck-wheat.

During the past ten years close upon 140,000 tons or 7 million bushels of *meslin* have been annually harvested, and arable land to the extent of 105,000 hectares (260,000 acres) is set apart for this purpose. The meslin is generally a mixture of barley and oats, with at times a slight addition of peas.

Peas are cultivated pretty generally in two varieties, yellow and gray, but chiefly in the most fertile provinces. Both kinds have been grown from time immemorial, and thrive as far north as in Norrland, where the gray variety is the more usual, while the yellow is mostly cultivated in the central and southern districts. Of late years, together with those of other seedlings, new, more lucrative, and improved varieties of peas have been brought to Sweden, and among these the Victoria seems to have gained ground, more especially in the most southern provinces, where this variety proves far more satisfactory, as a general rule, than it does farther north. Peas are sown to an extent of 30,000 hectares (75,000 acres) and other pulse (beans and vetches) occupy an area of about 25,000 hectares (60,000 acres.)

Fodder Plants. The approximate amount of fodder obtained in Sweden during ordinary years is seen by the following statement. About 870,000 hectares (2,150,000 acres) of the soil is devoted to growing fodder, and on an average about 3 metric tons of hay per hectare are cut, or all in all about 2 1/2 million tons. Add to this the produce of 1,600,000 hectares (4,000,000 acres) meadowland, which, at one ton per hectare, makes 1,600,000 tons, and the entire crop of hay amounts to between 4 mill. and 4 1/2 million tons. Moreover about 160,000 hectares (400,000 acres) are devoted to grazing and green fodder, finally the extensive pasturage must not be forgotten which — more especially in Norrland — exists and is included in the 35 million hectares (88 million acres) woodland and outlying ground in Sweden. Hay is produced in largest quantities from the fields, which in alternate husbandry, or rotation of crops, regularly return in the three- or four-year system, being chiefly sown with clover or timothy grass, many other plants now being often intermixed. As these various plants develop more or less quickly, and differ as regards stability, by degrees they replace each other so that the pasture becomes closer and the crop of fodder so much the greater. The compound consists of both grass and pulse, as besides clover and timothy-grass, there is rye-grass,

fescue, cocks-foot, fox-tail, common oat-grass, yellow clover, meadow-grass, vetchling, wild vetch, etc. The seed is sown in a protecting crop of grain, in Central and Northern Sweden generally in winter corn, while in Southern Sweden it is sown in spring corn, the quantity of seed sown being seldom less than 35 kilog. per hectare (30 lbs per acre). Quite recently, perennial pasturage has been adopted at a few places with more or less success.

Roots. The *potato* was introduced here in 1723 by Jonas Alströmer, a man, who stands second to none as regards the development of economics in Sweden, during the preceding century. The following average yearly crops have been obtained during the present century:

Years.	Hectolitres.	Bushels.	Bushels per inhabitant.
1811—20	2,250,000	6,400,000	2·6
1851—60	12,650,000	35,900,000	9·9
1861—70	14,150,000	40,200,000	9·9
1871—80	17,850,000	50,700,000	11·5
1881—90	18,140,000	51,500,000	11·0
1892	20,930,000	59,400,000	12·1

These figures are, however, too low. Potatoes are planted on altogether 155,000 hectares, or not quite 400,000 acres, and the average annual yield is stated to be 133 bushels per acre, while in very good years, it rises to 230 bushels in some places. The consumption keeps fairly even pace with the production, since, as a general rule, only very small quantities are either imported or exported. Of late years many new varieties of potato have been introduced in Sweden, the Magnum Bonum having become most popular, in consequence of its comparative immunity from disease.

The manufacture of *starch* is still carried on as a domestic occupation in those districts largely cultivating potatoes, but of late years this industry has gone over to the hands of factory owners. As a general rule it may be said, that in those places where the production of brandy has decreased, the manufacture of starch has increased, but there are no statistics as to in what ratio. The greater part of the starch produced is bought up by the press yeast manufactories.

Turnips, etc. About 15,000 hectares of arable land, or rather more than 35,000 acres, are planted with turnips and carrots, but this cultivation is satisfactory only in certain parts of the country, greatly depending on the difficulty experienced in obtaining sufficient hands to tend the growing crops. As dairy-farming gains ground, the root-crops are found more and more indispensable as fodder, more especially for young cattle.

Sugar-beet. This cultivation has been continued for more than 60 years in Sweden, but only during the last ten years has it undergone any important development. It is now exclusively carried on in the most southern part of the kingdom, Skåne, where about 10,000 hectares (25,000 acres) of the best arable land are used for this purpose.

Sugars, etc. In consequence of the great importance of beet cultivation as regards the development of rational agriculture, the beet-trade has been greatly favourized by the State. While a high import duty (at present amounting to nearly 3 cents per lb. raw-sugar of darker colour than No. 18 according to Dutch Standard) is laid on foreign sugar, the home sugar industry has been either free from impost, until 1873, or but a small duty has been levied. This excise now amounts to half the raw-sugar duty just mentioned, but is decided by the weight of the beets worked, under the supposition that they yield $6^1/_4$ per cent of sugar, whereas, the outcome being in reality about 10 per cent, the manufacture of beet-sugar enjoys a protection of about 2 cents per lb. Dating from the autumn of 1895, the excise will be based upon a supposed outcome of 9 per cent.

At present there are 10 beet-sugar manufactories, which are all in the hands of companies. These companies cultivate the beet in very small quantity, but instead buy up the beets from farmers in the neighbourhood; the farmers, in some manufactories, being shareholders. The raw-sugar is refined either at the beet-sugar manufactories, or at the older refineries, which were originally employed simply to refine colonial sugar, and have by degrees proceeded to the refining of beet-sugar, and whose owners are large shareholders in the beet-sugar manufactories.

In the year 1891 (at 8 manufactories) 272,000 metric tons of raw beets were worked up, the yield of which may be counted as about 27,000 tons of raw-sugar; during the same year 24,000 tons of foreign raw-sugar were imported, and 7,000 tons of refined sugar, so that the consumption of sugar may be calculated at 58,000 tons of refined sugar, 46 per cent being produced at home. As two manufactories have lately been opened, half of the sugar needed by our country may be said to be produced at home. In 1891 the excise paid for beet-sugar was $ 495,000, while for imported sugar the duty amounted to $ 2,447,000.

Honey. The raising of bees was in olden times very common in Sweden, but became less and less general as the mead for which the honey was used was more and more replaced by other beverages, and sugar became cheap and easily obtainable. This occupation, however, if properly managed, fully repays the labour expended upon it without taking into account the role that bees, as well as many other insects, play in the fertilization of plants. Private individuals, as well as the Agricultural Societies, recognizing this fact, have lately tried to excite interest in this occupation, which, in many parts of our country, is favoured by natural conditions. The Agricultural Societies have appointed persons to give advice and assistance concerning the care of bees, improved construction of bee hives, etc. In consequence of climatic conditions the raising of bees is confined to the southern half of the kingdom, but occurs exceptionally as far north as Luleå. The number of hives in the entire kingdom may be reckoned as about 100,000. As regards the production there are no statistics. During the years 1886—90 about 14,000 kilog. (30,000 lbs) of honey were annually imported, the export of wax being somewhat larger than the import.

Public Institutions for the Furtherance of Agriculture. The supervision of Swedish agriculture is conducted by the Home Department, the administrative Board of Agriculture being subordinate thereto, together with the Agricultural Academy, which is at present solely devoted to the scientific improvement of agriculture.

When, after the war in 1809, Sweden finding herself at peace, could devote her attention to pacific measures, attention was soon directed to the need of improving various industries, and thus in 1811 the *Academy of Agriculture* was founded, the members of which were to »pay attention to, and, by their care, further the progress of agriculture in the kingdom, and, occupying a position between Government and the cultivators of the soil, should lay before the former a statement of the condition, requirements, and defects of agriculture, while as regards the cultivators, the Academy was to prepare and facilitate the carrying out of those resolutions arrived at by the Government, with a view to increase their comfort and prosperity». In the neighbourhood of Stockholm the Academy has been granted special grounds for experiments made under scientific guidance.

As head of the *Board of Agriculture,* founded in 1890, there is a President, his immediate subordinates being a chief engineer, a superintendent of agriculture, and one of fishery. The chief engineer attends to matters relating to draining and cultivation, and to diminishing the frost-holding nature of the soil, while the superintendent of fishery gives his attention to fishing-matters, and to the superintendent of agriculture are entrusted all those matters that do not devolve on the two officials previously mentioned.

In close connection with the Board of Agriculture are the *Agricultural Societies*, in number 26, which have their regulations confirmed by the King, generally are fairly well off, and whose object is, — each in their own district — to further the development of agriculture and its by-industries. Each year they have to send in a report to the Board of Agriculture concerning their activity. Their income is chiefly derived from interest, members' subscriptions, and, above all, from the fifth part of fees paid for spirit-licences, which accrues to them according to law. The total income of all Agricultural Societies in 1890 amounted to 336,000 dollars and their assets at close of same year to 1,070,000 dollars.

The *High Schools* of Agriculture in this Kingdom are two, one at Ultuna near Upsala, in Central Sweden, the other in Skåne, at Alnarp. The former was opened in the forties, the latter not before 1862, and both own very extensive farms. There are 25 *Agricultural Schools* in different parts of the Kingdom, aided both by the State and the Agricultural Societies; these schools are located at large farms that are well managed, and as attention is chiefly paid to practical education, they are generally attended by a large number of young men, who there gain that knowledge which, after passing the course, will enable them to manage their own small farms, or, as a bailiff, to superintend the management of a large estate.

In certain provinces there are so-called *Chemical stations,* seven in all, which are likewise aided by both State and Agricultural Societies. Each station is under the supervision of a board chosen by that or those agricultural societies which contribute to its support. The farmers send in fodder, manure, soil, milk, etc. etc. to a great extent, so as to have them investigated or tested, and for the single period of five years ending 1890 the total number of tests made was 91,508. In addition to these chemical stations, there are 18 so-called *Seed-controlling offices,* where the different seeds intended for sowing and the market are subjected to examination and control. The idea in establishing these seed controlling offices was to discover, not only the germinative value but also the purity and other general qualities, which daily becomes of more importance as the soil is subjected to higher cultivation, for if the capital expended on the soil is to return interest, it becomes still more necessary than under ordinary circumstances, that the seed corn used should be of very best kind.

A due insight of the value of good seed for sowing has of late years prevailed among the farmers of Sweden, and has caused the formation of two *Associations* for this purpose »Allmänna Svenska Utsädesföreningen» and »Mellersta Sveriges Utsädesförening» which dating from 1893 will be amalgamated to one association whose headquarters will be at Svalöf in Skåne, where the former association owns buildings and large grounds for experiments. These associations likewise receive grants both from the State and also from Agricultural Societies. During the six years that the elder of the two associations, Allmänna Svenska Utsädesföreningen, has been at work, it has succeeded in 1) Creating and testing a new system for the methodical selection of seeds for cultivation, which is the most comprehensive and complete of any existing; 2) Constructing a whole series of apparatus and instruments for the practical application of the different methods of selection; and 3) Growing and bringing into notice a large number of new varieties of seed and pulse plants, which are at present under cultivation so as to be perfected according to this system. In conjunction with this work on cultivation, the society has undertaken an extensive series of experiments, all over the kingdom, at large or small trial fields in most of the Swedish provinces. On the other hand, Mellersta Sveriges Utsädesförening has been chiefly active in testing which kinds of seed are best suited for Central Sweden, and in one way bringing them into notice by distributing gratis the very best varieties, more especially to the small farmers, whose interest — as regards the use of only the very best seeds for sowing — the association, by these means, desires to excite, and has really succeeded in so doing.

Besides these associations, Sweden has another, receiving grants from both State and Agricultural Societies, and called the Swedish *Fen Culture Association,* whose efforts are devoted to awakening the interest of the Swedes as regards the cultivation and utilization of the vast fens, which exist to such a large extent in certain parts of the country. Their activity may be stated as consisting both in

extensive laboratory tests, in experiments made out on the fens, which are conducted by special assistants, and trials concerning vegetation, there being trial fields not only in the different provinces but also at the head-quarters of the Association. For this culture a special engineer is employed, who, during the summer, makes extensive tours, so as to impart information, and to counsel the fen cultivators in different parts of the country concerning the manuring, proper rotation of crops, etc.

Thanks to the support given by both public and private funds, and of which we have but made cursory mention, Swedish agriculture has rapidly developed and now ranks high when compared with that of other nations; the obstacles, which nature has placed in the path of the steady progress of development, have become drawbacks of less importance to the private individual, which is proved by the most superficial comparison between the present state of cultivation and that existing but a few decades ago.

Dairy and Dairy Products*.

Dairy-farming is in Sweden of very ancient date, as, from old chronicles, we learn that from the thirteenth to sixteenth centuries, dairy produce formed an article of export of no slight importance. During the seventeenth and eighteenth centuries the trade decreased, and only during the last three decades has it again become flourishing, and — thanks to new and improved methods and machines of home invention — has become so far developed that dairy produce (including pork) now stands second in rank among our exports, and in value is more than one ninth of the total amount of export.

At present there are about 2,000 dairies in the kingdom, which annually use up nearly 600 million kilog. (more than 150 mill. gallons) of milk, or about one third of the quantity of milk which the 1,200,000 milch-cows of the country may be calculated to yield.

Dairy-farming is chiefly carried on in the southern half of the country, and, more especially in the south-eastern quarter, has reached a high state of development, as Södermanland, Östergötland, and Skåne use up almost the half of the milk treated in all the dairies of the kingdom. Butter-making is the chief aim of ninety per cent of the dairies and scarcely ten per cent are devoted simply to the making of cheese.

The dairies are of three different kinds, viz:

Estate dairies, where butter is made from milk produced solely on that one estate; *association dairies*, which are owned in common by a large number of small farmers, who send their milk to the dairy and share the entire profits; and *purchasing dairies*, which are owned by private individuals, or companies, and where the dairy produce depends entirely on bought milk.

* By Dr. N. Engström.

In the first category we may reckon 62 per cent; to the second 5 per cent; and to the third 33 per cent of all dairies in the kingdom. The association system is spreading rapidly, and before long will probably oust a large number of purchasing dairies.

The size of the dairies varies from those that use up 10,000 kilog. (or about 2,600 gall.) of milk per day, down to those which prepare only a few hundred kilog. Generally tended by women, it is only the very largest, more particularly the Association Dairies, that have a male manager and staff. At most dairies, the milk is now reckoned by weight (kilog.), but here and there measure is still used (litre) and in some places the milk is valued according to its percentage of fat. The dairies are, as a rule, very well arranged, are provided with floors of asphalt, cement, lime-stone or slate, have very good and suitable appliances, and are generally driven by steam, though water-power is also used in many places. Where water-power is used, there is almost invariably a steam-pan or steam-heater for warming water, etc. and for cleansing vessels and appliances, for which purpose no means surpasses steam. The sums expended in dairies and fixtures may be valued at about 4 million dollars.

Butter-making. Among those dairies making butter, about forty per cent treat the milk according to the ice-method invented in 1864 by J. G. Swartz, where the milk creams in high oval cylinders of tin-plate, placed in ice-water for twenty four hours previous to being skimmed. About sixty per cent of the creameries use de Laval's far-famed Separators for skimming the milk, the cream issuing from the separator being immediately cooled down to 4—6° Celsius, this being done either in plate cylinders, sunk in ice-water, or with a cooling apparatus. In some dairies this cooling process is preceded by a pasteurizing to 63 to 70° C. thanks to which the quality of the butter is materially improved.

The cream thus obtained, by this or other methods and treatment, is now placed in cream-tubs of oak, or tin-plate with outside covering of wood, where, in from 12 to 20 hours, and at a temperature of 15—23° C. it becomes slightly sour, this being caused by the addition of butter-milk or by a specially prepared souring medium derived from sweet or skimmed milk (»pure culture»). At most dairies butter is produced solely from slightly soured cream, and is made from sweet cream simply at a few places, the butter being then sold fresh at the nearest town. All butter for export is made almost exclusively of slightly soured cream.

When the cream is ready for churning, colouring matter is added and it is churned at 10°—16° Celsius in so-called Holstein-churns, these churns being exclusively used in the creameries and butter factories, and also at many smaller dairies, where manual power is used; indeed churns of any other construction are in use at very few places.

The butter, when ready, is taken from the churn with a hair-cloth strainer, is rinsed by passing the strainer through water of 8—12° C. and is then placed in butter-troughs, being worked either by hand or by butter workers, and salted for

demands of different markets with from three to six per cent of salt. After being salted, the butter is left, for from 6 to 8 hours, in a eool place, after which it is again worked in the butter worker and plaeed in tubs (so called thirds) of beeeh, that are lined with parehment paper, and eontaining about an English ewt net. These thirds have the name of the dairy and country burnt in.

Maehines have recently been constructed for produeing *butter direct from the milk*, viz Separator's instantaneous butter-maker, the Extraetor, and the Radiator; but they have as yet only been used experimentally, chiefly beeause they only produee sweet butter, which has a very limited market, in consequenee of the present state of eommunication not allowing a quiek enough transport to England.

By far the greater part of the butter produced at the dairies, is exported onee a week to England. The progress this export has made during the past 30 years may best be seen by the following table, which, at the same time, shows the development of dairying.

Period.	Thousands kilog. per year.			Cwts per year.		
	Import.	Export.	Differenee.	Import.	Export.	Difference.
1861—65	1,068	166	— 902	21,000	3,300	— 17,700
1866—70	1,351	1,156	— 195	26,600	22,800	— 3,800
1871—75	1,518	3,155	+ 1,637	29,900	62,100	+ 32,200
1876—80	2,403	4,195	+ 1,792	47,300	82,600	+ 35,300
1881—85	2,719	8,020	+ 5,301	53,500	157,900	+ 104,400
1886—90	2,325	14,096	+ 11,771	45,800	277,500	+ 231,700
1890	1,776	15,043	+ 13,267	35,000	296,100	+ 261,100
1891	1,134	16,630	+ 15,496	22,300	327,400	+ 305,100
1892	877	17,125	+ 16,248	17,300	337,100	+ 319,800

Cheese-making is not of the same importance as butter-making, as seareely ten per cent of the dairies make cheese exclusively, though, at several of the butter-faetories, cream-cheese is made now and again, and many of these make cheese from skim-milk, which is, however, as a rule, sold for human food, or used for feeding calves, or fattening pigs. The members of the dairy associations generally take back skim-milk from the butter-factories, the milk being often previously pasteurized there.

The different kinds of cheese made from whole-milk are chiefly Cheddar, so-called »estate cheese» and Norrland's cream-cheese. The estate cheese is full of cavities distributed through its substance and resembles gruyère more nearly than any other cheese, while Norrland cream-cheese has small cavities and is very close. These two sorts find a market almost exclusively in Sweden, while the Cheddar cheese has a good export. Here and there other cheese is made, for instance, the so-ealled »Småland's priest-cheese», and the »Stoekkumla eheese» etc. are far-famed in this country. The skim-milk cheese is very elose, or has

very small cavities; at many creameries a spiced cheese is prepared from skim-milk which is very like the well-known Dutch seed-cheese (key-cheese). In the preparation of cheese, round cheese-vats, lined with tinned copper-plate, are mostly used; but of late years, more especially in the larger dairies, cheese-vats according to American models have come into use. Other plant derived from American models — such as cheese-knives and horizontal presses (gang-presses) and other appliances — are very general now. Otherwise the manufacture of cheese has made little progress during the very latest decades. Greater attention is at present, however, paid to the storing of the cheese, more especially concerning the heating of the storing rooms which, in many places, is done by steam, or hot water-pipes, thus rendering the cheese all the sooner ready for the market.

Whey is used chiefly for fattening pigs, but in some few places is, by boiling down, made into a kind of cheese. The production of cheese is about that of the home consumption, so that one year cheese may be imported, the next exported, as seen by the following table.

	Import. Kilog.	Export. Kilog.	Import. Cwts.	Export. Cwts.
1887	223,000	336,000	4,400	6,620
1888	215,000	235,000	4,230	4,620
1889	217,000	119,000	4,270	2,340
1890	195,000	144,000	3,840	2,830
1891	168,000	249,000	3,300	4,910
1892	195,000	189,000	3,840	3,720

Butter and cheese colouring matter, and also rennet extract, is manufactured among other places by S. Barnekow and M. Zadig in Malmö, A. F. Sjöstedt at Jönköping, at Lund Technical Manufactory, etc.; but as yet they cannot supply the demands of this country, for very many dairy preparations, as also all salt used in dairies, come from abroad.

Simultaneously with the development of dairying, more especially in the southern provinces of the kingdom, the **raising and fattening of pigs** has received a strong impetus; skim-milk, butter-milk, whey, etc. as well as grain and potatoes being used for this purpose. Many establishments undertake the curing of the meat for exportation, but live pigs are also exported, and the extent of this export may be seen from following table.

	Pigs.	Pork.	
	Numbers.	Kilog.	Cwts.
1884	50,167	323,000	6,360
1885	32,225	1,242,000	24,500
1886	31,960	1,588,000	31,300
1887	37,142	3,125,000	61,600
1888	171	4,735,000	93,200
	Kilog.		
1889	237,000	7,467,000	147,000
1890	170,000	5,961,000	117,400
1891	341,000	5,034,000	99,200

The total value of dairy products, and pork, as also of live pigs, exported in 1891, was according to official statistics S 9,800,000, and for the year 1892 may be calculated as about S 10,650,000.

The entire produce of the dairies must, of course, be considerably more than amount exported, and may be reckoned for 1892 as about 20 million kilog. or 400,000 cwts of butter; 2 million kilog. (40,000 cwts) whole milk cheese, $^3/_4$ of a million kilog. (15,000 cwts) cheese made of whole and skim-milk, and 5 million kilog. (100,000 cwts) skim-milk cheese; 8 million kilog. (160,000 cwts) pork and pigs. The total value of dairy products was in round numbers 13 million dollars. To this must be added no small amount of butter and cheese made at small farms for the wants of the household, or for sale in adjacent towns, which is of course outside our calculations.

Machines, vessels, and appliances needed by the dairies are now made in our country almost without exception, there being many manufactories for the purpose of supplying these wants. First in rank comes the SEPARATOR Co. Lim. of Stockholm that, at their extensive factories, manufactures separators, heating and cooling apparatus for milk, pumps and lactometres, lactocrite and butyrometres.

The Separator has during the course of a few years passed through a series of transformations. While during the first years of its existence, the separator was built only in one size and shape, skimming about 300 lbs of milk pr hour, it is now produced in sixteen different forms with skimming capacities from 100 to 3,500 lbs pr hour. The smaller sizes, i. e. up to and including 600 lbs capacity, are made to be worked by hand-power.

As an interesting example of the development of the separator it may be stated, that in 1878 it required an engine of two horse-power to drive a separator, skimming 300 lbs of milk in one hour, and to-day a small boy does the same work, in the same time, with a tiny hand separator; while the largest separator requires less than one horse-power to skim 3,500 lbs. The larger separators are either driven in the usual manner by gears and belting, or by means of a small simple steam-turbine, mounted in the base-plate of the separator itself.

At the present day there is no country in the world where de Laval separators are not working. The yearly output is about 5,000 separators besides a large number of other machines and apparatus, without which a modern dairy is not complete. These are *pasteurizers, heaters,* and *coolers* for milk and cream, and, last but not least in importance, those ingenious machines, which are used for determining the percentage of butter-fat in the milk and amongst which the *Lactocrite* is the most important. Perfected as it has been of late, it is acknowledged by the most eminent men of science in this branch to be almost as reliable as the most minute laboratory analysis which can be made; while at the same time it accomplishes its work much more cheaply both as to time and actual cost. The lactocrite is however not only of great importance in the butter-factory, but has also another use, of almost greater importance, viz. by the cattle-breeders for determining the best strains of milch cows.

The annual sale of the de Laval separators has of late years considerably exceeded $^1/_2$ million dollars, and the bulk of it is exported to foreign countries.

It is only natural that the success of the Separator Co. was not gained without great outlay of money and incessant earnest work in both laboratory and workshop. About S 250,000 has been spent on patents, of which the company owns or controls more than two hundred, in various countries. Quite a large staff of experts are constantly engaged in endeavouring still more to perfect and complete the various machines, and this, together with the costs for taking part in exhibitions, sending representatives all over the world and a number of kindred expenses, has up to date claimed $^1/_4$ million. In competition with other milk-skimming machines, of which probably more than a dozen exist, the de Laval separator has gained 225 first prizes.

Besides this company there are so-called »mechanical workshops» which turn out dairy machines, pumps of various kinds, churns, curd vats, and butter-

workers, cheese presses etc.; among others C. Holmberg of Lund, those of Westerås, Halmstad and Ystad, in towns of the same name, and Söderblom's Foundry in Eskilstuna, which also undertakes to plan and mount entire dairies. Wooden utensils, churns, troughs, and working machines for butter, cheese vats, etc. are made by the Ceres Manufactory at Waxholm, vessels of tin-plate at Olofströms Works and Kockum's Iron Works, C. A. Wedholm of Nyköping etc.

The progress dairy-farming has made during the past few years is owing mainly to the care and attention devoted to the subject by the Government and the Agricultural Societies.

The State supports a *Dairy College*, chiefly intended to train teachers and consulting dairyists in the management of a dairy, this course lasting a twelvemonth; and two *Dairy Schools* having yearly courses, and 18 *stations* for training dairymaids in a two years course. The State has also appointed an ambulant *instructor* of dairying, a stipendiary and a *dairy agent* in Manchester, whose duties are to work up the market for Swedish dairy products and constantly keep the dairymen well up in the demands and state of the English market. The State pays out about $ 10,000 a year under this heading.

The Agricultural Societies are now chiefly active in having, each within its district, duly appointed *consulting dairyists* or ambulatory instructors in dairying, who, after being called to the assistance of the owner, or manager, shall arrange the working of the dairy, remedy mistakes, give advice concerning new and improved methods of dairying, and make out estimates and plans for dairy erections.

In twenty-three out of twenty-six of the districts in which there are Agricultural Societies such consulting dairyists are appointed. Furthermore the Agricultural Societies have established *Control stations*, where, for a very slight payment, the degree of fat in the milk can be ascertained. At present there are 9 such stations at different places in the kingdom. Various societies, moreover, support dairy pupils, or own special dairy schools, some few for both men and women. Besides this, they give grants to *Dairy Shows*, which have of late years been systematically arranged, so that the butter from several dairies is there subjected to many tests and strict examinations several times during the year. The grants for these different aims amount yearly to about $ 20,000. The Agricultural Societies also greatly aid dairying by loans for dairy buildings to be had free of interest; formerly the sum thus annually lent often amounted to $ 30,000, but, owing to the development now reached by dairying, the loans have decreased very considerably, and are at present only held from four Agricultural Societies.

Tobacco, Textile Plants.

Tobacco. In Sweden about 1,300 tons of tobacco leaves are annually gathered either in the neighbourhood of Stockholm or chiefly in Skåne. The import of tobacco in 1891 was:

	Kilog.	Lbs.
Leaf tobacco	3,415,965	7,532,000
Cigars and Cigarettes	82,516	183,000
Other kinds	21,558	47,000
Total	3,520,039	7,762,000

The entire value thereof being $ 2,160,000. The export is not worth mentioning. In 1890 there were 85 tobacco manufactories, with 3,147 hands, and a total production of 218,000 kilog. (481,000 lbs) cut tobacco; 386,000 kilog. (851,000 lbs) cigars; 1,154,000 kilog. (2,545,000 lbs) roll and cake tobacco; and 3,454,000 kilog. (7,616,000 lbs) of snuff. The entire value of the tobacco manufactured was stated to be $ 2,870,000.

Textile Plants. From time out of mind, *flax* and *hemp* have been grown in Sweden, flax especially in the northern provinces Helsingland and Ångermanland, where it still continues to be an important object of culture. The indigenous flax culture is however so far from suffieient for the wants of the kingdom, that both fibre and seed must annually be imported. The dry plant yields about one fifth of prepared flax, and the crop varies between 2 and 4 ewts of flax and of the seed between 6 and 11 bushels per acre when the seed is reaped half-ripe, otherwise 11—17 bushels. The seed weighs about 54 lbs per bushel.

In 1890 there were 6,300 hectares (15,600 acres) of land cultivated for textile plants, the import of flax and hemp during same year being more than $2^1/_2$ mill. kilog. ($5^1/_2$ mill. lbs).

Spirits and Vinegar*.

Brandy-distilleries. As the distilling of brandy is still considered as a by-trade to agriculture, though it may also be undertaken by any person who is entitled to carry on manufacture, there are many limitations as regards the right of producing brandy, viz that such distilling may only take place between Oct. 1st and May 1st (exceptions concerning German or pressed yeast will be noticed below) and that at every distillery at most 25 hectolitres (660 gall.) alcohol per day may be distilled. So as to do away with the so-called »household distilling», formerly so common, the smallest amounts to be distilled has been fixed at 2·5 hectolitres (66 gall.) per diem, and at 40 hectolitres (1,056 gall.) alcohol for the whole time process continues.

During the twelvemonth ended $^{30}/_{9}$ 1892, 142 distilleries were being worked, of which 8 were also producing German yeast; of the other 134, only one was situated in a town, the rest were in the country. The amount of alcohol distilled in the twelvemonth 1891—1892 was in all 159,700 hectolitres (4,216,000 gall.). The production at most distilleries falls far short of the permitted quantity. Thus there are but 17 distilleries which produce more than 2,000 hectolitres (52,800 gall.) alcohol a year, and only three of these distil 5,000 hectolitres (132,000 gall.). The other

* By Dr. K. M. Lindeberg, Chief of the Brandy Control Office.

125 distilleries produce on an average but 820 hectolitres alcohol a year, the daily average for all distilleries being 8·2 hectolitres (216 gall.) alcohol.

As regards raw materials, potatoes were chiefly used, 1,220,000 hectolitres (3,465,000 bushels); maize (imported) 12,768 metric tons; rye 4,562 tons; mixed grain 3,799 tons; barley 1,318 tons; likewise wheat and oats to a very small degree; at some press yeast manufactories buck-wheat is mashed in, and also at one distillery sugar-beet syrup, 1,269 tons.

The *excise* is laid on the product when ready, and is 50 öre per litre (about 50 cents per gall.) of normal strength, i. e. of 50 per cent alcohol at 15° Celsius, or 1 dollar pr gallon alcohol, though two per cent is deducted as free of duty. For the excise, the brandy is gauged by an automatic control-apparatus (Siemens and Halske, Berlin) which also reduces the brandy to the normal strength. This control-apparatus was introduced 10 years ago and has given general satisfaction. The distiller has a right to store brandy under the seal of the State, and need not pay the excise until the brandy is taken out. The amount of duty paid, during the past five years, has, on an average, been $ 3,900,000 (4 mill. dollars in 1891).

The raw brandy produced at the distilleries is, as a general rule, rectified at special works, only very few distilleries being provided with rectifying apparatus. Formerly coal-filtred brandy was almost invariably used for comsumption, but at present this is almost totally replaced by brandy rectified by distillation. The largest works for rectification are Rejmersholm, near Stockholm, and in Upsala, Gothenburg, Kristianstad, Karlshamn and Motala.

The *brandy trade* is classed as wholesale, i. e. selling brandy in quantities of at least 250 litres (66 gall.), or as retail, when a smaller quantity, but not less than a litre, is sold, and retailing for consumption on the premises. Wholesale trade is permissible to every one entitled to carry on other trade, but for trading otherwise in brandy, or other distilled alcoholic drink, a license must be obtained from the municipal powers and Governor of the province. If the question be mooted within a certain time, that a license shall be granted for retailing or selling brandy for consumption on the premises in a commune, the communal authorities are to consider the question, and should they negative it, the question is settled for that year; if, on the other hand, they acquiesce, the matter is referred to the Governor on whose decision the matter depends. On the retailing of brandy being permitted in a commune, and the number of premises decided on, the licenses are put up to public auction, when the speculators must give the amount of litres of spirit for which they agree to pay the licensing fee of 15 öre the litre (15 cents per gallon); these applications being submitted to the Governor, who shall then take into consideration not only the qualifications of the applicant, but also the extent of the offer. Licenses can be obtained in this manner for a time of at most three years at one time.

In towns (and by Royal Assent in boroughs also) the retail trade in spirits

may be conceded to a company, specially formed for this purpose *(The Gothenburg System)*, but even then, application must be submitted to the Governor. These companies bind themselves not only to pay the licensing fee of sale which the company promised when making necessary application, but also to give up that profit which arises from the business. This system has been applied in Gothenburg since 1865; and in Stockholm since 1877, and has by degrees gained ground, so that it holds good in 77 of 92 towns in Sweden, and in 11 boroughs. The principle of the system is that the spirit trade in towns should be undertaken by persons who carry it on »not for gain, but out of kind concern for the working classes». These companies, — at any rate in the larger towns, where they have generally been managed on the above mentioned principle, — have been very active in advancing temperance, particularly by reducing the number of public houses and limiting hours of sale.

The retail-trade and sale of spirits for consumption on the premises is limited as regards time; retailing being only permitted week-days from 8 a. m. to 7 p. m., while the sale of spirits to be drunk on the premises may not take place before 9 a. m. on week-days, continuing till 10 p. m. in towns and till 8 p. m. in the country. On Sundays and holydays the sale of spirits may take place generally only to customers taking meals on the premises. The Governors, however, may make exceptions to this rule, and in towns have done so to a considerable extent.

The fees, which are paid for licenses, and also the profits of the companies, are divided according to certain principles, differing for various groups of towns and for the country, so that one part (at least $^2/_5$ of the sum) accrues to that town where the sale of spirits has taken place, and the other parts fall to the Provincial Council, Agricultural Societies and the country communes. During the twelvemonth 1890—91, the sum obtained from the sale of spirits was $ 1,725,000, the towns receiving $ 986,000, the Provincial Councils $ 294,000, the Agricultural Societies $ 218,000, and country communes $ 208,000; the remainder being paid in fees of receipts.

During this twelvemonth, the latest for which complete statements are available, in towns there existed 279 licenses for retailing spirits; 649 continued and 278 occasional licenses granted for the sale of spirits on the premises, the latter occasional licenses being granted by the Governor for a shorter period than one year; while for country communes the corresponding figures were 37, 141 and 83.

The *consumption* of spirituous liquors of all kinds (not including wine or ale) is gradually decreasing and may be calculated for the year 1891 as 310,000 hectolitres (8,184,000 gall.) of 50 per cent alcohol. The mean consumption per individual was per annum:

Period.	Litres.	Gallons.	Period.	Litres.	Gallons.
1856—60.....	9·50	2·50	1876—80.....	10·10	2·67
1861—65	10·68	2·82	1881—85.....	8·00	2·11
1866—70.....	8·88	2·34	1886—90.....	6·94	1·83
1871—75.....	11·83	3·12	1891.....	6·50	1·72

and has thus since 1875 constantly decreased.

In the year 1891 we imported 152,000 hectolitres (4,013,000 gall.) of 50 per cent raw spirits, chiefly from Russia, which, after being rectified, was exported, mostly to Spain, and 22,200 hectolitres (586,000 gall.) of spirits of different kinds for home consumption, about 11,000 hectolitres (290,000 gall.) cognac, and 8,000 hectolitres (211,000 gall.) arrac being included therein. Our export consisted chiefly of punch, 470 hectolitres (12,400 gall.).

Methylated Spirits. For that spirit which is used for scientific or technical purposes the duty is returned, if the spirit be rendered unfit for use as a beverage by certain additions made under proper control. The most usual way of making the alcohol impure is to add 1 per cent of commercial wood-spirit, and 3·3 per cent of pyridin base; though for certain trades, vinegar, oil of turpentine, hartshorn, etc. etc. may be used. The right of retailing methylated spirits may be obtained by every tradesman, but the spirit must be coloured (with a faint rose aniline). In 1891, a total of 5,760 hectolitres (152,000 gall.) of alcohol were rendered unfit for use as a beverage; 2,634 by being mixed with methyl; 2,063 hectolitres being used for the manufacture of vinegar; 69 hectolitres for scientific purposes, and 994 hectolitres for different trades, as hatters and carpenters, and also in colour and varnish works.

Vinegar is made almost solely from spirit, which, so as to avoid excise, is denaturalized by the addition of vinegar to such an extent that to one hectolitre alcohol, 6 hectolitres of hydrate of acetic acid are added. In 1891 there were 17 vinegar factories in our country, which in their manufacture used altogether 2,063 hectolitres (54,500 gall.) alcohol. There is, besides these, a factory (at Perstorp, in Skåne, owned by W. Wendt) where vinegar is obtained by the rectification of wood-vinegar (pyroligneous acid) which, together with wood-spirit, and other products, is obtained by dry distillation of wood.

Press Yeast is at present made at 8 manufactories connected with distilleries, 4 being in towns and 4 in the country. At these manufactories, the stills may be kept going during the summer months (May 1st to Oct. 1st) on condition that at least 20,000 kilogrammes (44,000 lbs.) of pure yeast (i. e. not including the addition of potato-flour) has been made during the previous winter (Oct. 1st to May 1st) and that, during the summer, at least 24 kilogrammes of pure yeast is made for every hectolitre alcohol produced. During the twelvemonth from Oct. 1st 1891 to Oct. 1st 1892 the output of the manufactories was 1,626 metric tons of pure yeast and 26,500 hectolitres (700,000 gall.) alcohol.

Malt Liquors*.

Brewing. By the introduction of the Bavarian method of brewing in the forties, the topfermented malt liquors, Swedish ale and small-beer, were supplanted

* By Engineer A. B. Heljestrand.

by bottomfermented lager-beer, and by degrees the trade became a regular industry. Most of the breweries, are, it is true, of small importance, and produce simply topfermented malt liquor, for at 371 breweries in 1890 the quantity of malt worked was less than 300 metric quintals (about 600 cwts), but on the other hand the other 183 breweries, which as a rule are lager beer-breweries, produced nine-tenths of all that was brewed in this country. From the 554 breweries in the kingdom, according to their own figures, the following quantity of malt was used in 1890 (in metric quintals à 220·5 lbs or nearly 2 cwts):

Breweries.	Metric Quintals.	Breweries.	Metric Quintals.
277	—150	26	1,500—3,000
94	150—300	14	3,000—5,000
51	300—500	11	5,000—10,000
78	500—1,500	3	10,000—25,000

The 183 large breweries mentioned above are the real representatives of the modern style of Swedish brewing, and as this industry was derived from the German, there is but little difference in purely technical matters between the two. The products are chiefly Bavarian (brown) and Pilsener (lighter) beer, lager-small-beer (weaker), and at some few breweries, porter. The smaller breweries chiefly produce small-beer which is made from a wort of but 4 to 6 per cent Ball. According to statements furnished by the brewers the following figures are given:

	1880.		1890.	
	Hectolitres.	Gallons.	Hectolitres.	Gallons.
Lager-beer (11—16 % Ball.)	586,000	15,470,000	945,000	24,948,000
Porter (16—20 % B.)	42,000	1,109,000	38,000	1,003,000
Lager small-beer (7—10 % B.) / Small-beer (4—6 % B.)	490,000	12,936,000	1,211,000	31,970,000
Total	1,118,000	29,515,000	2,194,000	57,921,000

As the production of beer is not taxed, the above figures can scarcely be considered accurate, but even should the production be somewhat larger, the manufacture of ale is nevertheless unimportant compared with the number of inhabitants which in 1890 was 4,800,000. The import of beer is but slight, varying as it has done between 2,000 and 5,000 hectolitres (52,800 and 131,000 gall.) during the past ten years. This is perhaps largely owing to the heavy duty. The export is scarcely worth mentioning now, though in 1874 it was more than 5,700 hectolitres (about 150,000 gall.).

As raw material, when making malt liquors in Sweden, barley-malt and hops are used almost exclusively; substitutes for hops being unknown. The barley which is worked into malt is of home production (Skåne, Gotland and Öland produce the best barley for brewing), and is estimated as being about 480,000 metric quintals (945,000 cwts), being about one seventh of the entire yield of barley; most of the breweries make their own malt.

Hops, on the contrary, grow but sparingly in Sweden and are then of poor quality, so that almost the entire demand must be supplied by import, chiefly from Bavaria and Bohemia. The amount of hops imported was, annually:

Period.	Metr. Quintals.	Cwts.
1861—70	1,774	3,495
1871—80	2,531	4,986
1881—85	3,336	6,567
1886—90	4,124	8,118

The preparation of the malt and wort does not differ in any essential degree from the Bavarian and Bohemian processes. These are also followed as regards fermentation, but it must be mentioned that the so-called »Hansen's reform», which consists in using pure-cultivated yeast, has not only gained approval, but is also very prevalent in the breweries, to the great advantage of the trade. The storing of lager-beer and treatment in the cellar is the same as in Bavaria and Bohemia. The new modes of procedure that are peculiarly American, have gained no footing here.

As the beer, when ready, is generally bottled — in bottles containing one-third of a litre — before leaving the brewery, and this expense is naturally great, the price of lager-beer, even at the brewery, is pretty high, being about 21 cents (18—27) per gallon, even though brewing, as mentioned previously, is not taxed. Since 1891, however, the question of taxing malt-liquors has come under the consideration of the Government, that seem to incline to a malt-tax, but meet with opposition chiefly from prohibitionists and good-templars. Partly as a defence against the violent attacks of teetotallers, partly with an idea of pushing their industry, in 1885 the Swedish brewers, instigated by Anders Bjurholm, an eminent brewer, formed the Swedish Brewers' Association which at present has 330 members. The efforts of the association have lately been concentrated in setting up an experimental and training establishment for brewing in Stockholm.

Hitherto the necessary *machines and apparatus* have been made from German models, or been imported from Germany. The Danish endeavours towards reform have, however, called forth a suitable and promising invention made by a Swedish engineer, Axel Bergh, who has constructed a closed centrifugal apparatus, in which the wort is not only submitted to the action of sterilized air, but is also freed from substances eliminated by the boiling. The rotation forces the wort, which has been aired at will, through a closed cooling-apparatus, also constructed by Bergh, which differs from a Baudelot cooler by the wort running inside and the cooling water outside. By using this method, the wort enters the fermenting tub sterile, which is an essential advantage not only for those breweries which use pure-cultivated yeast according to Hansen's method, but for one and all. By this method the aroma of the hops is better retained and infection prevented. Bergh has moreover, with Alfred Jörgensen, greatly simplified the Hansen-Kühle yeast-propagating apparatus, and improved it in so far that the

different parts — the wort cylinder and the fermentation cylinder — may be cleansed and sterilized without the yeast being removed from the apparatus.

As the sale of bottled beer became general at an early date in Sweden, it is natural that attempts were made to construct suitable corking or bottling-machines. Wikström of Stockholm succeeded in inventing a machine, which in respect to its solidity and simplicity has not yet been surpassed; the Germans, utilizing this practical invention, made some unimportant modifications and now supply, especially from Hamburg, almost the entire globe with this excellent and easily managed apparatus. In close connection with the question of corking there is also that of the stamping of the corks, which is often done at the breweries. The older cork-stamping machines worked very unsatisfactorily, but since 1891 a machine (patented by A. Bjurholm and V. Alderin), appeared in the market, which as regards ease of management, precision, and telling-control holds a prominent position. The mechanism of the teller is remarkable for extreme simplicity and solidity and the apparatus, while stamping, exercises a strict control concerning the number of corks purchased.

Farming Tools, Implements, and Machinery *.

Among the circumstances which, during the last few decades, have had a powerful influence on agricultural prospects in Europe, competition from other parts of the world, and more especially from America, certainly ranks first. The fall in price of both grain and cattle, at the same time that wages and other expenses have risen considerably, has compelled the farmer to obtain the highest possible profits from his farm, while attempting to bring down the expenses as low as possible, and so as to attain this result, the very first condition has been to use mechanical contrivances to replace expensive human labour and make the ground yield the greatest possible return. While a great many undertakings have either made no progress, or suffered entire shipwreck, the production of machines and implements of husbandry has made rapid progress and in Sweden especially, where cheap motive power and good material are both easily obtainable, a spirited industry has of late years flourished, which in many respects can compete with the very best productions of foreign countries in the same branch.

Tillage. So as to cultivate the soil by manual labour, *spades, shovels, pitchforks, hoes, draining-apparatus*, etc. are used, mostly produced in our own country, and among eminent manufacturers of such implements, Vedevågs and Borggårds Works, Eskilstuna Pitchfork Manufactory may be named, and the productions of these works can well bear comparison with those of foreign markets. The ordinary tilling of the soil in Sweden is accomplished by animal power, and the machines and implements which are used are double mould-board and

* By Director R. T. Hennings.

other *ploughs*, *harrows*, *grubbers*, and *rollers*. The double mould-board plough is the most ancient of these implements, and though in general superseded by the ordinary plough, it is still used in certain provinces and, on fallow lands, works well. More complete than the mould-board plough is the ordinary plough, which is far more general, and is found at every little farm; the making of which has, in Sweden, reached a perfection which no other land can equal. Our best ploughs and similar implements are made at Öfverum Works, established in 1850, and since that time so greatly enlarged that while in 1852 their output valued but $ 5,000 it now runs to about $ 130,000 a year and the products of the Works are fully appreciated, not only in our own country, but also far beyond our territories, as there is a yearly export of ploughs to Russia, Finland, the Argentine Republic, Brazil, Australia, England, Spain, and various other countries, representing a yearly output of $ 40,000. In making ploughs destined for foreign use, the Works have brought their productions in accordance with the wants of various contries in this respect, and consequently turn out a vast number of ploughs of the most various sizes and construction. In our own country one-shared ploughs are chiefly used, since the many-shared have gained few adherents in consequence of imperfect workmanship.

Among other works where ploughs are manufactured we must not forget Norahammar, Hjelmafors and Näfveqvarn, as also the Gothenburg Engineering Works, all turning out first-class implements.

There are various harrows or cultivators destined to pulverize the soil at the surface, free it from weeds, and prepare it for being sown, as also those that go deeper into the ground, harrow in the seed, etc. and for the different purposes, various harrows more or less deep-going are made and are well worth notice. Of a purely national character is the so-called *scarifier* or »goosefoot» harrow which is considered as quite Swedish, and the *roller-harrow* which is originally a Norwegian invention, though similar constructions are now to be found in most countries. Grubbers are very little used and then only in those places where sugar-beet is cultivated, and where the soil must be worked to a greater depth. Rollers of many different kinds are used according to the hardness of the soil. Among rollers of recent construction the »ringrollers» have gained much favour and are made in great numbers. Among older but most effective rollers, those of Swedish bar-iron give a good result and are much used, more especially in heavy and hard clayey soils.

Steam-power for the cultivation of the soil is as yet but little used, some ten years ago a few steam-ploughs were introduced from England and used on large estates in the south and central parts of Sweden, but in consequence of various reasons the results did not equal the expectations raised, and at present the use of steam-power for purely field work only occurs very exceptionally and no home manufacture of steam-ploughs takes place.

Planting. *Sowing-machines* for hand are used only when sowing grass or

esculent root seed, and for this purpose very simple machines are used, that are made in this country.

Machines requiring animal power, for grain and artificial manure, are however, very prevalent, both of native and foreign make, and during the past few years the former have gained ground. Some years ago broadcast sowing-machines were often employed that simply sowed the grain without harrowing it in, but as agriculture improved and experience taught the vast importance of the complete and equal harrowing in of the seed, broadcast sowers for grain have been superseded by corn-planters, which at the same time sow and harrow in the grain. In Southern Sweden, corn-planters of German or English manufacture are used provided with thills and constructed according to the so-called box-system, while in Central Sweden, where the fields are generally of smaller dimensions and often encumbered with stones and other impediments, Swedish corn-planters without thills, are chiefly used which, after American models, and according to the so-called roller system are made by the VESTERÅS Machine Manufacturing Co. The fabrication of these machines is in a most flourishing condition, and on many occasions when competing with other machines they have gained high honours, so they are now largely used.

Machines for spreading manure are little manufactured here, but are generally imported from Germany. No steam sowing-machines are in use.

Harvesting. As manual implements, *scythes*, *sickles*, *rakes* and *pitchforks* are used, which are of home manufacture and which, more especially for scythes and pitchforks, follow American models. The scythes are usually excellent. The enormous production which characterizes farming of the present day, and the consequent necessity of getting in the harvest in the shortest possible time has greatly accelerated the use of animal power in different ways for harvesting, and nowhere has there been such speedy development in the production of agricultural machines as in the manufacture of reaping-machines for animal power.

A few years ago the so-called *combined harvesters*, which with a slight alteration could be used both for grass and grain, were in vogue, but the make was perfected, farmers, demands rose, and at present, simple reaping-machines are used for grass, and reaping attachments or self-binding reaping-machines for grain. The manufacture of the two last mentioned machines is unimportant in Sweden and the demand is supplied by importation chiefly from America, but for mowing-machines, during the past 10 or 15 years, a home industry has arisen of such perfection that it can fully bear competition with the best foreign productions. The more important manufactories for Swedish mowers are ÖFVERUM Works previously mentioned, PALMCRANTZ AND Co., Stockholm, VESTERÅS Machine Manufacturing Co., and ROTTNEROS Works in Vermland, all these Works manufacturing mowing-machines both for one and for two horses. At Vesterås the manufacture of mowers and corn-planters, etc. was begun in 1875, and owing to the great confidence gained by the machines, the output has constantly increased,

and is now valued at about $ 130,000 yearly. Palmcrantz and Co. of Stoekholm devote their attention entirely to mowing-machines which are consequently brought to a high state of perfection. This company was formed in 1877 and sinee then has sold no less than 11,160 mowing-maehines. The sales have eonstantly inereased and in 1890 rose to $ 100,000. The harvesters — both with reaping attachment and self-binding — which have in Sweden gained the best footing, are those made by Walter and Woods of New York, whieh are so highly thought of, that hitherto they have ousted all other kinds of similar machines. The self-binding maehines are used only at very few places, as their great eost, involved meehanism, and eonsequent difficulty in their eare, as yet prevent their general use.

The American »Tiger» rake has been the model on whieh Swedish horse-rakes have been formed, and the home produee is fully sufficient for the demand.

Preparatory to marketing. As the returns of farming have increased, greater demands have been made in the eonstruction of *thrashing machines*, so that with slight expense they might combine the greatest possible durability and working power, and those machines made in Sweden have as yet kept paee with those of foreign lands. In many places in Sweden water is used as the motive power for thrashing-maehines and even wind now and again, but on large estates steam is used as a rule, and on smaller ones, horses or oxen. As to the eonstruction of the thrashing-maehines, both flails and peg-drums are used or else an intermediate between the two, the beater-drum system prevailing at the larger, while the peg-drum system is in use at the smaller thrashing-mills. Most of the thrashers are provided with straw-shakers, and in the larger mills, more or less perfeet apparatus for cleaning and assorting the grain are to be found.

The chief maker of large and eomplete thrashers is Munktell's Engineering Works of Eskilstuna, which was founded in 1852 by T. Munktell, after whose deecase the present eompany was formed. Its speeiality eonsists in loeomobiles (transportable steam-engines) and thrashing-machines, and of the former 1,101 have been manufactured to a value of $ 1,225,000, while of the latter 742 which sold for $ 460,000. By far the larger number of these maehines found home purchasers and only a few were exported to Finland, Russia and Buenos Ayres. The manufacture has been raised to a high degree of perfeetion and as only materials of the best Swedish products are used and the work itself is done with the aid of the best and most perfect maehines of the day, the maehines, both as regards construction, durability, and eheapness, ean eompete with the very best products of English manufaeture in this braneh.

Among important Swedish manufacturers of middle sized and small thrashing-machines, J. Thermænius and Sons of Hallsberg, and the Köping Maehine and Tool Faetory, may be mentioned, both supplying thrashers of first-elass quality.

Coneerning the import and export of thrashing-maehines, a few of large size are imported from England, while smaller ones are exported by us to different foreign eountries. Clover seed is thrashed in ordinary thrashers and after the

husks have been separated from the chaff they are treated by the so-called clover-hullers, which are made by many machine manufacturing firms in Sweden, though these machines are not widely spread.

The increased demands, which have of late years been made for pure and homogeneous quality of the seed for sowing, have in most countries called forth a brisk competition in the fabrication of *sorting-machines* for grain and seeds, more particularly in Sweden, where seed-corn is produced of first-class quality, which is largely sent abroad, and not only have the inventions of other countries been used, but some machines have been constructed here that have been widely adopted. So as to separate the seed or grain from the chaff, or other light impurities, *winnowers* are employed; while for the separating the lighter from heavier grain, so-called *corn-fans* are used; and to separate grain of the same weight, but differing in form, either from one another or from worthless seeds of the same form, sorting-machines are called into play. Winnowers and corn-fans are invariably of home manufacture, while the more complicated sorting-machines are mostly imported from Germany or England. The chief manufacturers of sorting-machines in Sweden are the before mentioned J. Thermænius and Sons, the Öfverum Works, etc.

Applicable to farm economy. The demand for *transportable steam-engines* is, at present, great and their manufacture increasing day by day. A few years ago English locomobiles were mostly employed, but since the home fabrication, during the past decade, has made great strides, the use of foreign locomobiles has very much decreased. In consequence of the capital material used in the Swedish locomobiles, the critical tests the machines are submitted to before placed in the market, and owing to the complete preventives against accidents which, according to Swedish law, must be taken by the manufacturer of every machine, the Swedish locomobiles rank high among similar products from other parts of the world. The boilers are made with the utmost care from the very best Swedish Martin steel-plate and the riveting is accomplished by hydraulic machinery; the axle, connecting-rod, and piston-rod, etc. of the machine are made of the best Bessemer steel; the tubes are made of great length so as better to utilize the heat; the fireplace is unusually large so as to use up all waste fuel; new inventions concerning safety-valves, feed-heaters, spark-catchers, etc. have been applied, while the weight and volume of the machines have been reduced to the last degree possible. The chief manufacturers of Swedish portable engines, besides Munktell's Engineering Works, are the Atlas Works in Stockholm and the Kristinehamn Engineering Works etc.

So as to crush fodder and esculent roots, *chaff-cutters* and *root-cutters* or pulpers of several different models are used, though, for chaff, those are preferred which for different wants can be adjusted for cutting the chaff of various lengths, and for the roots, those that cut but do not crush them.

For the *crushing of grain* and fodder-cake, mills and crushers are used,

while for mash, small mills with serrated rollers have been employed, and for coarse meal, mills with vertical stones, which with but little expenditure of power give a good result; but as the steam or wind motors are more generally used, by degrees the mills with large horizontal stones have gained ground as giving a far better result, both as regards quantity and quality. All the above machines for crushing grain and fodder are made in Sweden for the home market, and are not exported or imported in any degree worth mentioning.

In conclusion, as regards the Swedish manufacture of implements and machines and its connection with that of foreign lands, the words of Mr. W. W. Thomas, U. S. Minister in Sweden, may be cited:

»There was at one time a good market for our agricultural machines, but the Swedes have learnt to manufacture these articles for themselves and now reign supreme in the home market.»

Fertilizers.

About 1875 Sweden commenced to manufacture phosphoratized manure or so-called superphosphates, and this industry has developed so that in 1890 the manufacture rose to more than a million dollars. Sweden is very rich in conglomerates, which are very suitable for the preparation of superphosphates. The vast stores of apatite in the northern part of the country (Gellivara), which have lately been brought to light, and from which a more or less phosphatic iron-ore is obtained, give an ample supply of raw material for this industry. The slag obtained from the basic Bessemer process, the so-called Thomas slag, is also used for manufacturing manure. These manufactories, of which the chief are located in Skåne (Helsingborg), have a struggle for existence with foreign competitors, nevertheless in 1890 superphosphate was exported to a value of $ 18,000.

Among other manures that are manufactured on a large scale, bone-dust and fish-guano may be mentioned. In 1890 there were no less than 22 bone-dust manufactories with an output to the value of $ 53,000. Urate, or bog-earth saturated with urine, and bog-earth pudrette are also produced but not to any great extent.

Fats and Oils.

Among *animal fats,* that are largely produced, tallow and margarine are observable. The export of tallow seems to be on the increase, and in 1890 rose to the value of $ 97,000, while suet was exported for $ 26,000. Margarine of good quality is also manufactured, and at the head of this trade stands the Arboga Manufactory. In 1890 the value of the output was $ 130,000. During the same year train-oil was exported, valuing $ 62,000. There is also a manufactory for producing fish-oil, with a yearly average output valued at $ 8,000.

Vegetable oils are made in Sweden in large quantities. The value of the product of 13 oil-mills at work in 1890 was $ 625,000, the manufacture of pressed

oil-cakes for fodder alone amounting to $ 217,000. During the same year different kinds of vegetable oils were exported, as linseed-, rape-, and rapeseed-oils to a value of $ 34,000. Among other vegetable products to be included in this group are rosin, terpentine, wood-oil and lamp-black, these products being made at 9 manufactories, and their combined value in 1890 being $ 27,000.

Forestry and Forest Products*.

The Forests and Woods of Sweden. The entire area of the outlying ground of this country, including fells and unreclaimed land such as bogs, fens, etc., is, in approximate figures, 35½ million hectares (88 million acres); the forest bearing ground being calculated as somewhat more than the half of this area, or about 18 million hectares (45 million acres). The area of *public forests* (inclusive of unreclaimable land) is 7,307,000 hectares (more than 18 million acres) or 20½ per cent of the entire outlying ground; the area of the Crown Parks is yearly increasing, to a large extent, by the purchase of private woods.

The woods consist chiefly of *pine* and *spruce*, which grow throughout the entire kingdom, either as pure forest or mixed, and provide the great bulk of the timber export. The pine appears unmixed on our gravel hills and more extensive heaths; the spruce on moist clayey soil and on brash; the larch, which in suitable situations attains a good size, has, of late, been largely imported. The Weymouth pine is planted now and again in lighter soils, and is sometimes used as an undergrowth for pines. The silver-fir and some other kinds of foreign trees are planted in several places in the southern and central provinces of the kingdom, but are of no importance for our timber culture.

The *birch* occurs either as pure forest, more especially in the extensive uplands, or in company with pines, firs, and aspens. The *beech* is found only in Skåne, Halland, and Bleking, and certain parts of Westergötland and Småland. It is, however, rapidly being superseded by coniferous trees. The *oak* appears in groves, paddocks, and parks, up to the Dal River, but does not form any large continuous bodies, except at the island Visingsö (lake Vettern), where there is a large oak plantation of about 400 hectares (1,000 acres) belonging to the State. The *ash, elm, maple*, and *lime*, extend to same latitude as the oak, but are not so numerous; the *alder* grows as pure forest on marshy soil and attains a very fair size; the *aspen* occurs over the entire country, both together with other trees, or as pure forest, and gives a much sought-for wood for the Swedish safety matches. The mountain-ash, white-beam, bird-cherry, gray alder, and some different kinds of willows, also grow in Sweden.

The Administration of the Woods and Forests. The central governing board of the woods, forests, and farm domains of the State (Royal

* By C. G. Holmerz, Director of the Forest Institute.

Board of Domains) is formed by one director-general, five chief secretaries, and a sufficient number of subordinates; it being under the Finance Department. The local administration is conducted by 9 headmasters of the forests and 74 masters of the forests, there being 263 rangers. Besides the ordinary officials and subordinates, there are 141 supernumerary masters of the forests and 375 keepers and bailiffs; there are also 6 forest engineers, paid by the State, to aid the owners of private woods in due care of forests, etc.

Laws concerning Woods and Forests. The most important enactments concerning the forest-culture of the woods and forests of the State are those of 1866 anent Forest Law; the woods and forests of Norrland in 1874; and of 1889 anent instructions for officials in woods and forests.

The Crown Parks and Blowsand Plantations are cared for by the State, that also appropriates the revenue. The same applies to the undisposed and spare ground and unassigned forests in Norrland; the timber yearly cut, and pasturage of these woods, being put up at public auction, and knocked down to the highest bidder.

The woods let on lease with any of the domains of the State, are cared for by the person holding lease, according to a fixed plan of management.

The woods belonging to the larger official residences are, as a rule, cared for by the State, the others by the persons in tenure, who, besides their own needs as regards wood, are, for their pains, allowed, at the utmost, half the net profits from the woods, the rest of the profits, in the case of the ecclesiastical residences, going in part to a fund for salaries of the clergy, and partly to a »forest fund», which defrays the expenses of cultivating those woods belonging to ecclesiastical residences, which cannot support themselves; from most other residences to the public treasury.

Woods appertaining to public institutions, such as churches, hospitals, colleges, etc., are cared for by the board of the institution, under control of the State.

In those woods, or forests, belonging to the State, which are let to certain privileged saw-mills, a certain number of trees are yearly *marked* for felling after survey, and for this a certain tax is paid (»wood rent»).

Those woods allotted to certain mines are mostly cared for by the owner of the mine, according to fixed rules of forest culture.

The inhabitants of settlements and Crown Farms in Norrland, besides their own fuel, are allowed a survey for sale, and under certain conditions may, after having inherited the use of these farms, obtain right of domain thereto.

The commons are mostly husbanded by the officials of the woods and forests, the expenses being refunded to the public treasury; the receipts, after the expenses of management have been paid, being divided among the inhabitants of the district either in money or wood.

The private landowner, as a general rule, has the complete power of disposal of his woods, but with following exceptions: 1) In the Lapp districts no timber-

eutting for sale may take place unless a master of forests has previously made a survey; the same rule holds good for eertain soeage tenements in Upper Norrland, whieh have arisen in eonsequenee of settlers not having fulfilled their duties; 2) In the coast parishes of Norrbotten and Vesterbotten, unless by special permission, no tree of less diameter than 21 eentimetres, at a distance of $4^3/_4$ metres from the roots, may be felled for sale or exportation; 3) In Gotlands distriet, the Royal Governor has the power of forbidding any timber being felled for sale on those tenements where the owner has wasted the woods to such a degree that natural regrowth is jeopardized.

The Husbanding of Woods and Forests, Time of Circulation. In the publie forests, as also in the large private woods, in the central and southern parts of the country, so-called bloek-hewing is generally prevalent, either by charcoal working, or in leaving seed-trees, or timber matter. The time for eirculation in these places is between 80 and 120 years for eoniferous woods. In the more distant forests of Norrland, thinning is undertaken with an interval of from 200 to 250 years.

Felling and Transport of the Timber. In those woods set apart for timber eutting, or thinning, the work is done during eertain winter months, the timber is then transported during the winter to the streams, which will float it down, or to the plaee of consumption. The wood intended for fuel is hewn, and laid up in eords where eut, generally remaining there until the following winter.

The long winters and plentiful snowfalls make the transport of timber an easy thing by land, it being taken from the wood to the river, or to the publie roads, and thenee to the railways. The large streams and rivers are of the utmost importanee, sinee by far the larger portion of the timber hewn is floated down to the eoast. The different saw-mill companies, that are cutting timber along a stream, join together in forming a floatage eompany, which undertakes the floating of all timber brought to the stream.

In floating down timber, it is of the very utmost importanee that it arrives at its destination as quickly as possible, since it deteriorates, and part of it sinks, if allowed to remain too long in the water. All obstaeles to floatage that may be in the water-course, as stones, rocky shallows, and rapids, must be removed, or obviated by eaissons, booms, or channels made for floating down the timber. In many water-eourses, enormous sums have been sunk for this purpose. During the few weeks time that the spring tide lasts, the floatage in a single water-eourse may employ as many as 4,000 men, but then between three and four million logs are brought down.

Renewing of the Woods. Regrowth is generally obtained by self-sowing trees, which, in most parts, proves very satisfaetory, more espeeially if, after timber-felling, the brushwood was burnt. When the seed-trees or »timber-matter» has been left on parts eut, or if a suitable regrowth be already there, the brushwood, a year after the timber has been eut, must be collected in heaps for the burning, which

should be done early in the spring, so that the seed-plants, or regrowth, may not be damaged by fire. Should there not be these obstacles to the burning of the brushwood, it may be set fire to on the lee side of the cutting, after all combustibles have been removed from a space of twenty feet on the opposite side. The fire passes rapidly over the cutting, but consumes only the dry brushwood and weeds, thanks to which a good seed-bed is formed, which is soon covered with vigorous plants. When the regrowth has come so far that it no longer requires the protection of the seed-trees, these latter may be cut down either at once, or by degrees, unless they consist of young vegetative timber trees, in which case they may remain and grow into the new compound, thus giving rise to a dual form of pure forest which is very favorable to the production of huge timber. On large bare cuttings, or wastes, which are to be wooded, two or three-year-old school-plants are often set with the clods of earth still adhering to their roots. On loose and somewhat moist soil, which is not too overgrown with grass, one or two-year-old plants are set. On very stony ground, where planting would be extremely dear, sowing is customary.

The Timber Trade and Export. As a consequence of the vast riches in woods possessed by Sweden, in comparison to the number of her inhabitants, no economy has been practised as regards home demands until the very latest decades. The amount of wood annually used for buildings, fences, fuel, and carpentry, it is of course difficult to determine, but it may certainly be reckoned as by ar exceeding the figures of our export. Nor must it be forgotten that for charcoal, used in the production of iron, about five million cubic metres are annually employed. Notwithstanding the vast home demand on wood, the forests give so largely, that timber, in wrought or unwrought form, ranks first among the Swedish exports. In the fifties and sixties the liberal opinions which then were prevalent, both in home and foreign laws, gave rise to a number of industrial establishments for woodwork, among which saw-mills especially made rapid progress.

The chief districts for lumbering extend northward from the town of Gefle along the Gulf of Bothnia. Here the great bulk of lumber is cut and sawn, more than 80 per cent of the timber export being shipped from Bothnian ports, such as Sundsvall, Hernösand, Söderhamn, Gefle etc. The district of Sundsvall alone sends into the market $^1/_5$ of all the Swedish timber. Besides this, lumber operations are conducted on both the east coast at Kalmar, Vestervik, and Oskarshamn, and on the west coast, where Gothenburg exports the products from the forest districts along the Klar River.

The export of unwrought timber, logs (sawn or hewn), has on an yearly average reached the following value and percentage of the entire export of the country:

Period.	Dollars.	Per cent.
1871—75	22,710,000	41·43
1876—80	23,667,000	42·08
1881—85	25,864,000	39·60
1886—90	26,403,000	36·14

For the three semi-decades 1871—85, it has been calculated that of the *value* of all the unwrought wood exported, the principal articles had following percentage:

	1871—75.	*1876—80.*	*1881—85.*
Deals and boards	78·4 %	80·0 %	81·0 %
Beams and spars	12·5 »	7·8 »	6·8 »
Round wood	3·4 »	6·4 »	5·6 »
Pitprops	2·8 »	2·6 »	2·9 »
Sundries	2·9 »	3·2 »	3·7 »
Total	100 %	100 %	100 %

The extent of the annual export has on an average been, in cubic metres:

Period.	Deals and Boards.	Deal- and Board-ends.	Beams and Spars.	Roundwood.
1871—75	2,225,000	104,000	443,000	153,000
1876—80	2,619,000	143,000	374,000	149,000
1881—85	3,248,000	218,000	392,000	189,000
1886—90	3,755,000	283,000	281,000	188,000

For deals, battens and boards, which are the most important articles in this group, the *value* of goods exported during past five years was:

	Deals and Battens.	Boards.
1887	$ 12,817,000	$ 5,567,000
1888	17,134,000	6,684,000
1889	17,539,000	8,025,000
1890	15,674,000	7,976,000
1891	16,307,000	8,277,000

The yearly export of wrought wood has been of the following value:

Period.	Dollars.	Per cent of entire export.
1871—75	1,726,000	3·15
1876—80	2,840,000	5·05
1881—85	3,607,000	5·52
1886—90	4,893,000	6·70

Among articles falling under this heading, matches and wood-pulp are of most importance, the value of their export being in 1887—1891:

Year.	Matches.	Woodpulp.
1887	$ 2,364,000	$ 766,000
1888	2,482,000	2,062,000
1889	1,830,000	1,959,000
1890	2,109,000	2,157,000
1891	2,525,000	2,396,000

The total value of forest products exported in 1891 was:

Timber (unwrought)	$ 29,848,000	Berries	$ 56,000
» (wrought)	6,372,000	Tar	141,000
Bark	45,000	Charcoal	8,000
Pitch	2,000	Wood-spirit	1,000
Rosin	3,000	Total	$ 36,523,000
Lamp-black	47,000		

The art of producing *tar* is very old in Sweden and has been a remunerative occupation in many remote districts, but is nowadays carried on principally in the two most northern provinces of Norrland. During the winter the resinous timber is brought to the »tar-pit», where it is burnt during the following spring and summer. The prepared tar is floated in barrels down the rivers to the coast places, whence it is exported to foreign countries. Half of the entire production is shipped from Umeå. In 1892, the export amounted to about 6,500 tons.

Forest Colleges. In 1828 a high-school of forestry was established in Stockholm with a view of diffusing a more general knowledge of the economy of forestry and the chase, as also for training, theoretically and practically, men who would follow out its precepts. The tuition at this *Forest Institute* is given gratis to the pupils. The staff of the institute consists of the Director, two professors and five other teachers. So as to obtain admission as a pupil, it is requisite to have a healthy and strong frame, to have passed the examination for admittance to the University and a preparatory one year's course at the Omberg School of Forestry. The course at the Forest Institute is of two years' duration. In 1892 the number of pupils was 22. *The Forest Schools* are intended, by gratis instruction, to give chiefly practical insight and skill in forestry and hunting; at the Omberg School pupils are prepared for the Forest Institute, while the other five schools are devoted to the training of foresters, or rangers. The number of pupils at the Forest Schools was 60 in 1892.

DEPARTMENT B.

HORTICULTURE, VITICULTURE, POMOLOGY, FLORICULTURE, ETC.†

Much labour has been successfully expended on Swedish soil in general, from which fact gardening has derived great benefit, although, as a source of industry, it occupies a subordinate position.

The entire area of orchards, hop-gardens, and cabbage-grounds was, in 1891, about 35,000 hectares (86,000 acres).

Pomology.

In Sweden the cultivation of fruit-trees can only be carried on successfully in the southern and central provinces. In the valley of Mälaren, orchards are very common, but farther north the cultivation of fruit can only be carried on with complete success in specially favoured localities, and finally, only along the coast. The most northern orchards that still give satisfactory results are in the neighbourhood of Hernösand.

Those kinds of fruit-trees which are almost exclusively cultivated in Sweden are apple, pear, cherry, and plum. Only in Skåne and, as espalier fruit, somewhat farther north, can early peaches and apricots be grown in the open air, but this cultivation is carried on but very sparsely. It is, however, pretty usual in Sweden to grow apricots, peaches, and nectarines — sometimes figs also — under glass. The walnut-tree grows in Skåne, Gotland, and at Kinnekulle, where it attains a very considerable height.

Among those different kinds of fruit, which thrive best in the climate of Sweden and which are consequently generally cultivated, the chief are:

Apples (Pyrus Malus, Swedish: *Äpplen*):

Arvidsäpple*, Astrachan* several varieties, Fageröäpple*, Frösåkersäpple*, Gravensteiner, Grågylling*, Gul Richard, Gyllenkroks*, Hampus*, Hornbergsäpple*, Hvitgylling Klaräpple*, Melonäpple (Nonetity), Ribston Pippin, Rosenhäger*, Rossviksäpple*, Sparreholmsäpple*, Säfstaholmsäpple*, Åkeröäpple* (best winter apple of Sweden).

† By Director E. Lindgren.

* Native sorts or grown in Sweden.

Several American varieties of apples. as the Baldwin, Nedhead, Northern Spy, Toolman's Sweet, Thompkin's King, etc., have lately been introduced, but do not seem suitable for Sweden. The Baldwin, for instance, does not come to perfection even in Skåne.

Besides these, let us mention that Siberian Crab Apples (Pyrus baccata and Pyrus prunifolia) are cultivated in many varieties, and that even north of Luleå they stand the climate well, and yearly bear ripe fruit.

In general the apple-trees in Sweden bear fruit in abundance, which in succulence and flavour is excelled in few other places. It frequently happens, however, that unfavourable weather, and, still oftener, the larvæ of the butterfly cause such injuries that the apples are either undeveloped, or ripen too late.

Pears (Pyrus communis; Swedish: *Päron*);

Aspa hushållspäron*, Augustipäron*, Bergamot, several kinds, Beurré, several kinds, Bonchretien, some of the early varieties, Ceciliapäron*, Duchesse d'Angoulême, Flemish Beauty, Fulleröpäron*, Grenna rödpäron*, Gråpäron, Hofstapäron*, Kanelpäron, Moltkespäron, Stenbergs kärnlösa höstpäron*, Åkerö sockerpäron*.

The climate is less favourable for pears than for apples. Even when cultivated as wall-fruit in the southernmost parts of the country, the foreign varieties bear no comparison with those from abroad, and the winter pears, especially, often fail.

Cherries (Bigarreau Cherries: Prunus Avium; Swedish: *Sötkörsbär*; Duke and Morello Cherries: Prunus Cerasus; Swedish: *Surkörsbär*):

Bigarreau, several kinds, as common yellowish-red, Napoleons, Rivers Early, Rockport, etc., Archduke, Glaskörs, Gros Gobet, May Duke, Montmorency, Morello English, Ostheimer, Reine Hortense, Van der Nat.

Cherries of all sorts thrive well as far north as Stockholm, both the acid and sweet varieties sometimes growing wild.

Plums (Prunus domestica; Swedish: *Plommon*):

Admiral Rigny, Common yellow*, Augustiplommon*, Columbia, Diamond, Early Favourite, Esperens Gold, Hackmansplommon*, Jefferson, Katrinplommon, Kirke's, Mirabelle Montfort, Reine Claude, several kinds, Prunes, many varieties, Shropshire Damson, Washington, Egg-plums, several sorts.

Small Fruits. The climate of Sweden is especially favourable for fruit-bushes as gooseberry, currant, and raspberry. Only the very early kinds of gooseberry can be cultivated to advantage as far north as Luleå and Haparanda, whereas currants and raspberries grow wild in the most northern tracts, and therefore can be cultivated there. Blackberries, however, can only be cultivated in Central Sweden and then but the very earliest kinds.

Gooseberries (Ribes grossularia; Swedish: *Krusbär, Stickelbär).* Many hundred varieties of gooseberries are cultivated, the best being:

Aaron, Achilles, Apollo, Atlas, Banck's Dublin, Bank of England, Bear White, Beauty Green, Blanc d'Angleterre, Bloodhound, Britannia, Briton, Bumper, Bunker's Hill, Catharina Ohlenburg, Cheshire Cheese, Clifton, Darling, Defiance, Drum Major, Favourite, Foxhunter, Golden Crown, Golden Yellow, Green River, Green Willow, Highlander, Highwayman, Independent, Invincible (Rivers), Jolly Angler, Jolly Miner, Jolly Printer, Keen's Seedling, Leg's Britannia Red, Leveller Greenhalghs, Lion's Provider, Mahlesfield, Maid of the Mill, Marigold, Melon, Monstrueuse, Nailer, Nettle Green, Nordy Lady, Ostrich White, Princeboy, Prince Regent, Reveller, Rob-Roy, Rough, Royal Sorrester, Rule alv, Röda syltbär*, Red Sweet*, Seedling Red, Smiling Beauty Yellow, Smuggler, Sproffon's Goliath, Great green

* Native sorts or grown in Sweden.

smooth*, Great green oval*, Great green smooth thin-shelled*, Great yellow smooth extra*, Great yellowish green smooth*, Great light green thin-shelled extra*, Great dark green thin-shelled*, Great dark red thin-shelled*, Great red smooth*, Great red oval hairy*, Swedish early green* (for north of Sweden), Swedish early yellow* (for north of Sweden), Two to one, Victory, Wandering Girl.

Currants, Red (Ribes rubrum; Swedish: *Röda Vinbär*). Many kinds are cultivated in Sweden, the best being:

Red sorts: Red Dutch (Swedish: Röda Holländska), Fay's Prolific and Cherry (Swedish: röda körbärsvinbär); and white sorts (Swedish: hvita vinbär): Gonduin à fruit blanc, Impérial à fruit blanc, Macrocarpa, Transparent White, Verrieres blanc, White Dutch.

Currants, Black (Ribes nigrum; Swedish: *Svarta Vinbär*):

The best of these have in Sweden proved to be Lee's Prolific and Black Naples.

As something out of the common it must be mentioned that both red and black currant-bushes occur in the most northern parts of Sweden perfectly wild, and it is even supposed that they had their origin in these districts, and have been carried thence to other countries.

Raspberries (Rubus Idæus; Swedish: *Hallon*):

A good many kinds of this fruit are cultivated in Sweden. The very best of all, those with red fruit, that have been tried here, is the Hornet, a hardy and prolific sort with very large berries, and next in order come the Antwerp Yellow, Belle de Fontenay, Falstaff, Jaune de Malta, and the Stenberg (native sort).

Strawberries (Swedish: *Smultron*) grow just as well in Sweden as in other countries, the same varieties occurring as elsewhere. During so-called bare winters, they must however be covered with firbrush, etc., so that the frost may not kill them. Several American sorts such as the Fillmore, Kerr's Prolific, Sharpless, etc., thrive very well in Sweden. Wood-strawberries are pretty generally grown under glass, so as to obtain fruit early.

Floriculture.

The cultivation of flowers in Sweden has been brought to a high state of perfection, both in the open air and under glass. As the days of summer are very long, plants both thrive and flower out of doors, and as they are sown early in the spring in hotbeds, the plants are pretty far advanced at time of being planted out, which is generally done at end of May or beginning of June, so very many kinds of flowers can be cultivated which we should scarcely dream of finding under such northern latitudes. It would take too much space to attempt to enumerate all or even some of those flowering plants that grow in the open here in Sweden. Most of the ornamental annuals that are cultivated far more to the south thrive well in the open here, and a goodly number of perennials do the same. Many bedding-plants, as pelagonias, fuchsias, etc., spend the winter in a greenhouse, so that during the summer they may be used to ornament the grounds.

The cultivation of plants in pots is pretty much the same as that carried on in the greater part of the rest of Europe.

Culinary Vegetables.

The cultivation of culinary plants has in Sweden reached a high standard of perfection both in the open and in hotbeds, and is prevalent over the whole country. As far north as Luleå and Haparanda, and even still farther north, a large number of culinary vegetables reach perfection, such as early white-heart cabbage, cauliflower, early peas, Swedish and the ordinary turnips, beet root and many others.

As a general rule, the climate of Sweden is very favourable to similar cultivation, but of late years the number and consequently production of market gardens has increased so greatly that the produce has fallen in price, and this cultivation no longer pays, as it did formerly. The culinary vegetables most generally grown are:

Asparagus, Artichoke French and Tubers, Beans, Bush and Pole, several varieties, Beet, ditto, Cabbage, Carrot, ditto, Cauliflower, ditto, Celery, ditto, Chicory, Chives, Cress, many sorts, Cucumber, several kinds both in the open and under glass, Dill, Horse-Radish, Kale, Kohl-rabi, Leek, Lettuce, Melon, several kinds simply under glass, Nasturtium or Indian Cress, Onion, various sorts, Parsley, Parsnip, Peas, many kinds, Pumpkin, Radish, Rhubarb, Salsify, Scorzonera, Spinach, Squash, Tomato, with success only in southern Sweden, Swedish Turnip.

Besides these many other culinary plants are cultivated, though not so generally.

Arboriculture.

A large number of trees and shrubs are cultivated, being partly of foreign origin, many having come from North America.

Among the most important, as regards Sweden, are:

Acer platanoides, Æsculus Hippocastanum, Alnus glutinosa, A. incana, Amelanchier Botryapium, Ampelopsis Hederacea, Aristolochia Sipho, Betula alba, B. verrucosa. There is a very beautiful variety peculiar to Sweden, with deeply lobed leaves, which differs in no slight degree from other lobed birches; its name is Betula verrucosa dalecarlica (Swedish: Ornäsbjörk), Caragana arborescens, Carpinus Betulus, Cornus, Corylus Avellana, Cratægus, Elæagnus argentea, Evonymus europæa, Fagus sylvatica, Fraxinus, Ligustrum vulgare, Lonicera, Mahonia Aquifolium, Philadelphus, Prunus (several kinds as Avium, Mahaleb, Padus, virginiania etc.), Ptelea trifoliata, Pterocarya caucasica, Quercus, Rhus, Ribes, Rosa, Rubus, Salix, Samhucus nigra, S. racemosa, Spiræa, Symphoria racemosa, Syringa, some kinds and many varieties, Tilia, Ulmus, several kinds and many varieties, Viburnum, etc.

Institutions for instruction in gardening, etc. The largest nursery in Sweden is at the so-called *Experiment Grounds* near Stockholm belonging to the Royal Academy of Agriculture, though there are many other nurseries in the southern and central provinces; some also in the northern part of the kingdom, indeed so far north as Luleå (nearly 66° N. Lat.). The methods employed for propagating trees and bushes, as also their general treatment, are the same as in other countries.

The process of development, which gardening has undergone of late years in Sweden, is to be attributed not only to increased enlightenment, but also to the example given by a number of large estate owners, on whose land this cultivation had for some time flourished, and the encouragement shown by the Government, Agricultural Societies, and private associations.

Besides the two important *Botanical Gardens* at Upsala and Lund, which are more especially intended for academical tuition, but are moreover of great importance as institutions for testing and acclimatizing, we must not omit to mention the Experiment Grounds of the Royal Academy of Agriculture, a large space, where a considerable number of park and fruit-trees and ornamental shrubs are raised, and trials made to acclimate and utilize them, as well as our kitchen herbs and decorative plants. The school for gardeners at the Experiment Grounds and the school of the *Swedish Horticultural Society* are the chief educational institutions in the kingdom. Instruction in gardening is also imparted at the *Bergius Gardens* near Stockholm; at the Agricultural High Schools of Ultuna and Alnarp; and at the Schools of Agriculture (see page 47), distributed over the whole kingdom; all these institutions being under the control of the Royal Academy of Agriculture.

The firmest basis for this branch of culture lies, however, in its being made a subject of national education. Gardening is taught at the Seminaries of National School Teachers and, furthermore, at all national schools in the kingdom there are *school gardens,* for which purpose the parish must grant the necessary ground. These gardens should contain the most usual culinary herbs, a few medicinal plants, an arboretum, etc. The children there learn to work in a garden and each year receive trees and bushes to plant at their own homes.

The Agricultural Societies employ so-called »master gardeners of the province», who must aid the public with advice and information. *Horticultural Societies,* to the number of about twenty, spread all over the kingdom, are active in promoting shows, publishing and distributing publications, imparting instruction, and supplying plants and seed.

The railways, which by their neat buildings, have in no slight degree contributed to the improvement of the houses of the peasantry, in the same way, have effected untold good by their gardens adjacent to the stations.

Parks and public gardens are now very usual in our towns, being generally well kept. In this respect the capital ranks first, as it can bear comparison with many other larger towns, that are situated in far more favourable latitudes.

DEPARTMENT C.

LIVE STOCK — DOMESTIC AND WILD ANIMALS*.

Next to agriculture, live stock breeding and dairy-farming counts as the most important source of income of our country.

The Swedish Government and the Agricultural Societies, 26 in number (see page 47), are powerful co-operators for the improving and developing of live stock breeding. Every year a fixed sum is reserved by the Government for the general agricultural meetings that are arranged, every five years, in varying parts of the country. By the institution of funds, where loans for the purchase of breeders are obtained at liberal terms, by yearly contributions for prize competitions of horses and cattle, and by appointing teachers of breeding and management of the different kinds of domestic animals, as well as of dairy-farming, the Swedish Government has been powerfully promoting the general and rational development of live stock breeding. The Agricultural High Schools and Schools are mentioned above, page 47.

Veterinary Surgery is supported by the State through a Veterinary Institute situated in Stockholm. and by the appointment of a veterinary surgeon in each province. The provinces are divided into several districts, each one with a district veterinary surgeon, who is paid by the Agricultural Society and the Provincial Council. The Agricultural Societies chiefly busy themselves with the development of those branches of live stock breeding of vital importance to each separate province and consequently worthy of encouragement. This is effected by the purchase and sale of breeds, suitable for the province, by contributions to prize competitions, by the arrangement of smaller district meetings, exhibitions of fatted cattle, horse fairs and exhibitions of dairy products, etc.

The Agricultural Societies have appointed *province-agriculturists* and *dairy-instructors* for assisting agriculturists by advice on live stock breeding and dairy-farming, and they will also grant the funds necessary for the training of cow- and horse-keepers, blacksmiths, dairy-maids, etc. The Agricultural Societies deserve special mention for the way in which the cattle *prize-competitions* have been arranged with the principal view of aiding the lesser farmers and keepers of live stock. Captain Sigge Flach is the founder of this system, and it was first intro-

* By O. E. Arenander.

duced in the province of Skaraborg in 1883 (hence its name of the *Skaraborg system*), then in the province of Östergötland in 1884, and has since been adopted in most of the provinces of Sweden. [For attaining more unity and collaboration the State will, from 1892, contribute a sum equal to that granted by the Agricultural Societies, provided that they submit to and act in accordance to certain rules issued for the cattle prize competitions in general. Only live stock keepers owning less than 50 hectares (124 acres) of arable land may join in these competitions with female animals and receive money awards and permits for gratuitous use of a prize bull. The prize jury is composed of three members, two of whom are chosen by the Agricultural Societies and one by the different farmers' associations. This system as well as the institution of »bull-associations» amongst the lesser farmers, who procure bulls at cheap terms from the Agricultural Societies, has been the chief agent in improving the live stock breeding of the lesser farmers.

The stock of cattle shows the following figures:

	1865.	*1870.*	*1880.*	*1890.*
Horses	428,169	428,446	464,820	487,429
Oxen	282,844	269,762	289,071	253,735
Bulls	37,791	38,647	47,985	49,066
Cows	1,185,556	1,231,477	1,409,236	1,578,927
Young cattle and calves	417,163	426,014	481,465	517,763
Sheep and lambs	1,589,875	1,595,009	1,457,462	1,350,804
Goats and kids	133,132	124,326	107,663	86,980
Swine and pigs	380,165	354,303	419,197	644,861

Besides this, there were in 1890 some 300,000 reindeer and 2,300,000 poultry.

With regard to numerical changes in the various kinds of animals, we find the number of horses the same at the commencement and the close of the first quinquennium; the following twenty years show an increase, whilst the number of bullocks is diminishing since 1880. These facts are connected one with the other, and are caused by the horses in many places replacing the oxen in agricultural work, a more suitable breed of draught horses being introduced. Otherwise there is a constant increase in the cattle stock, especially with regard to the cows, on account of the importance of milk production caused by the development of dairy-farming. The stock of sheep on the contrary shows a constant decrease in numbers, and this is still more the case with regard to the goats. The swine and pigs show the largest increase, their number being nearly doubled in the last 25 years in consequence of the enormous development of dairy-farming.

Besides we should observe the fact of these numbers relating to the numerical increase only, the increased value per head caused by careful breeding, feeding and management not being even alluded to, though certainly of no small importance.

The proportions of the live stock to each thousand of the population will be illustrated by the following statistics, showing the number of animals of each separate kind:

	1865.	*1870.*	*1880.*	*1890.*
Horses	104	103	101	102
Oxen	69	65	63	53
Bulls	9	9	11	10
Cows	288	295	309	330
Young cattle	101	102	105	108
Sheep	386	383	319	282
Goats	32	30	24	18
Swine	92	85	92	135

In the years 1871—1890 the annual import of live cattle has amounted to $^1/_3$ per cent of the total value of the imports of the country; comparatively the export has been much larger, viz. $3^1/_3$ per cent of the total value of all the exports. In 1890 cattle were imported to a value of $ 429,000, of which $ 310,000 came from Finland, the export of cattle was valued at about $ 2,680,000, of which $ 1,662,000 went to Denmark and $ 661,000 to England.

Horses.

The *native breed* of horses is supposed to be of Tartar origin and to have been introduced by immigrants from the East; the small pony still to be found in Gotland may be considered possibly a descendant of this breed. It has grown larger on the main land by plenteous feeding, but at present it will hardly be found pure in any place. Proportionally to its bulk, the energy and perseverance shown by the native horse were indeed wonderful.

As one of the last known representatives of this native, unmixed breed of horses we may mention the »Brandklipparen», famous in history, originally a country nag from Småland. He commenced his glorious career at five years of age in the battle of Lund 1676, where he was given to Charles XI by a Småland trooper, the horse of the former being shot, and afterwards he was frequently used by the king. In 1700 he followed Charles XII to Liffland, and at the battle of Pultava in 1709 he is said to have saved the king's life; later he was brought to Turkey, in Bender he was captured and afterwards redeemed. He then carried the king on his famous ride to Stralsund, was again captured, but was restored in 1715, returned to Sweden and died at Lund in 1718, 47 years of age.

Of foreign breeds, the *Norwegian horse* has been widely spread in the upper part of the country; in the mining districts of central Sweden his characteristic qualities have been best kept, viz. hardiness, contentment, and sure-footedness not to be surpassed. In order to supply agricultural wants in Southern and Central Sweden several different breeds of horses have been imported since 1850, as the *Percheron horse* which has exercised a favorable influence on the breed of horses in many places, and principally the *Ardennes horse,* which since 1860 has been chiefly spread in the provinces of Central Sweden as the kind of farm-horse specially suitable for the conditions of these parts of the country. A powerful frame, a brisk trot, and a calm but nowise slow temperament are the qualities that will be inherited by the offspring, when he is crossed with other breeds. A large percentage of the draught horses of the cities consists of half-breed Ardennes horses, which are very popular and sought for even by foreign horse-dealers. Amongst

other breeds of draught-horses the Clydesdale has chiefly been imported to Skâne, and, of late, experiments have been made with the so-called Shire-horse, though as yet there is no evidence of its being suitable to our conditions.

On different occasions good specimens of English thorough-bred horses have been imported by the State, by the Agricultural Societies and by private persons and associations. Most of them have been stationed in different provinces to serve as stud-horses and their offspring have been used as remounts, and coach- or saddle-horses. In order to supply the want of larger horses for these purposes, Hanoverian and East Prussian steeds and stallions have been imported.

Studs have been founded by the State in various parts of the country with the principal view of furnishing horses for the army. The most ancient is the one of Flyinge state farm in Skâne, founded in the middle of the 17th century, that of Strömsholm in Vestmanland is of a somewhat later date, about 1870 both of them were changed into depots of stallions. The stud of Ottenby was founded in Öland in 1831, but was abolished after the fire in 1891. The depots of stallions now in existence chiefly keep thorough bred or superior half-breed horses, which are stationed as stud-horses in different parts of the country.

Annual prize-competitions of suitable breeders are arranged in certain centres in the different provinces by a prize jury, appointed by Government and the Agricultural Societies that jointly furnish the means required. For the further improvement of horse-breeding, the Agricultural Societies import suitable horses, which afterwards are sold in the provinces. Of late they have commenced the keeping of stud-registers, in which the light or heavy horses of the province are filed, their lineage being known.

The average annual import of horses in the years 1881—90 was 2,185, but in the last years there has been a decrease; in 1890 the import amounted to 1,247 and in 1891 to 876 head. Most of the horses imported are furnished by the neighbouring countries of Finland and Norway.

The average annual export of horses in the years 1881—90 was 2,825 and consequently somewhat exceeded the import. In 1890 the export had risen to 3,868 horses, and in 1891 to 4,564, the export of this year exceeding the import by 3,688. Most of these are sold to Denmark, whence they are sent to Paris and Berlin to be used as cab-horses. In 1891 the horses exported to Denmark were 4,421, whereas but 143 were exported to other countries.

Cattle.

The hornless cattle, called alp- or *Jemtland breed* and still existing from Dalecarlia to the Finnish frontier, is supposed to be the native Swedish breed of cattle.

The typical alp-cow is hornless, its color generally white with black or dark brown ears and muzzle, more or less spotted with dark on the sides of the body

and legs. The height does not exceed 4 feet, the length is about 6 feet. She is a hardy and unpretentious domestic animal, excellently adapted for the conditions of Norrland, where no other breed would be able to replace her. Feeding on the rich, nutritious alpine pastures she produces an excellent milk with high percentage of fat, from which a superior kind of cheese, called »Norrland»-cheese, is specially manufactured. She would, however, prove unfit for the conditions of central and southern Sweden, her size being too small for the state of development attained by agriculture in these parts of the country.

The so-called *Gotland* or *Småland breed* may also count as a native breed, the characteristic features of which are a long head, curved bridge of the nose, long horns with an upward bend, a long neck, thin haunches and strong legs, the color generally a light red with white marks on the head and belly. Nowadays it is to be found only in Gotland and Småland, where it has chiefly been crossed with the Ayrshire-breed. The young cattle of this race are bred and sold for milk-cows and specially for beasts of draught.

With regard to foreign breeds, after many experiments the Ayrshire and in certain cases the Shorthorn and Dutch breeds have been found the races most suitable to our various wants.

The *Ayrshire breed* is the one most widely spread in Sweden, from Skåne as far north as the Dalelfven. The first specimens were imported in 1846. Since that time and especially in later years, such a number of Ayrshire cattle has been imported by the Agricultural Societies as well as by private persons that, at the present time, more cattle of this breed is to be found in Sweden than in Ayrshire. The Ayrshire breed greatly resembling our native horned cattle, even the half-breed will show the form and qualities characteristic to Ayrshire cattle, which will not be the case with various other breeds. When the Ayrshire cattle has remained in Sweden for some generations and been acclimatized it will grow somewhat larger and stronger and produce more milk than the animals originally imported. Moreover the Ayrshire cattle having proved a very hardy and contented race, it will generally thrive well even on scanty pastures. This is the reason of its having spread in the central and southern parts of Sweden to an extent unrivalled by any other breed, the more so because of its being a good milker with a good body. In 1890 121 Ayrshire bulls and 32 heifers were imported by the Agricultural Societies and only a few animals of other breeds. Registers of the Ayrshire cattle of pure lineage to be found in the different provinces have been commenced by several Agricultural Societies for the preservation of the breedmaterial existing.

A limited stock only of *shorthorns* is to be found in our country on account of their requiring a great deal of care and fodder. The pure breeds of dairy shorthorn formerly imported have become extinct, but still, shorthorn bulls are frequently used. *Dutch* (or Ostfrisian) cattle were imported as early as in the 16th

century, but they seem to thrive only in Skåne in connection with the culture of sugar-beets.

Besides these breeds, several other good stocks may be found in our country, though not sufficiently important to command any notice.

Stock-farms were founded by the Swedish Government in 1846, mostly with Ayrshire bred cattle. They were stationed in different parts of the country, but in 1869 most of them were sold, though not before the animals had improved our stock of cattle in many places. In 1890 we find 1 stock-farm belonging to the State at Alnarp and 5 owned by different Agricultural Societies.

Milk production and dairy-farming have been largely developed in the last twenty years, and in consequence of this the number of cows has increased by about 400,000.

The average import of cattle in the years 1881—90 was 2,250 head per annum, most of them were sent from Finland to Norrland. The whole of the import in 1890 was 7,307 head, but fell in 1891 to about the half.

The average annual export of cattle in the decade 1881—90 was 32,365 head, in 1890 it rose to 36,379, but fell in 1891 to 30,441 head. The animals exported chiefly consist in fatted cattle which are sold to Denmark. In 1891 $^2/_3$ of the whole export went to that country, and about $^1/_7$ to England.

The average import of *meat* in the decade 1881—90 was about $1^1/_2$ mill. kg. (3,307,000 lbs), and the export only 192,000 kg. (423,000 lbs). In the last years however the export has increased to a considerable extent, in 1891 it amounted to 360,000 kg. (794,000 lbs), the import on the contrary having sunk to 1,260,000 kg. (2,780,000 lbs) of which 928,000 kg. (2,047,000 lbs) came from Finland.

Sheep.

The *native* Swedish sheep is nowadays to be found in a pure strain only in certain parts of Gotland, even in mediæval times renowned for its sheep breeding and excellent wool, and is also kept by small farmers in the main land, chiefly in Norrland. The head is small, the neck long, the trunk narrow, the pelvic part rather well shaped and sloping, and the legs are strong. The wool is fine and of a grey, white, brown or black color. It is a hardy and unpretentious animal, and in Gotland it will feed in the open air all the year round.

In the 16th and 17th centuries German and English sheep were imported, though not exercising any lasting influence on the native breed. This was not effected before 1726 by the *Merino sheep* then introduced by Jonas Alströmer. More sheep of this breed were afterwards imported, so that in 1766, according to calculations, Sweden was possessed of 90,000 merino sheep and 22,000 mixed breed. These merinos were bred in Sweden, until in 1860 they began to be replaced by English sheep with coarse wool. A few scattered stocks are still to be found, and in many places marks of this breed will remain. In 1860 the *Southdown sheep*

was very much the fashion, and was introduced in Sweden; at present many good stocks of this breed are to be found in the country. The *Cheviot sheep* has been imported to Gotland, Dalecarlia and several other parts of the country and is considered the breed most suitable for crossing and improving the native breed.

In the southern and more fertile parts of the country the Southdown breed has been displaced by the Oxfordshiredown, Shropshire and Disley sheep, breeds of larger size and more rapid growth, but also exacting more care. Of these especially the Oxfordshiredown sheep has been widely spread.

The number of sheep is diminishing in Sweden; from 1865 to 1890, according to statistics, the decrease was about 300,000 or 12 per cent. It must however be observed that nowadays the sheep are better fed and kept and consequently the decrease in number of the sheep stock does not necessarily involve a reduction in value.

The first *sheep-farm* of any importance was founded by Jonas Alströmer at Höjentorp in 1729. With this for a model several others were instituted and were still existing in the sixties, when the changed prices of wool and meat made the »woolsheep» unsuitable. In 1871 the sheep-farm stock of the State were sold. In the period between the founding and abolishing of these sheep-farms, various efforts had been made for improving sheep-breeding, as: prizes being awarded for fine wool, the founding of a »wool-office», the institution of a »wool-fair» etc. At present only one sheep-farm of the Cheviot-breed is still existing, in Gotland.

Fatted sheep are produced and the export is increasing year by year. In the decade 1881—90 the average export of sheep per annum was about 33,000, the import only amounting to 740. Denmark takes about $^2/_3$ and England $^1/_3$ of the total export.

Wool is imported in increasing quantities, the country not being able to produce the amount required for its own wants. At the merino sheep-farms still existing in Sweden, an exceedingly fine wool was produced, which for instance received several first prizes at the London exposition in 1855 and was mentioned by the jury in very complimentary terms. The import of wool has increased proportionally to the industry based on it, and in the decade 1881—90 amounted to about 2 mill. kg. (4,400,000 lbs) pr. annum. The export is not worth mentioning.

Goats.

The goat was formerly bred to a much greater extent than is now the case. It has been forced to yield to the rational forest management, and to the more thorough system of agriculture now practised, and has been exiled to the rocky and woody provinces of northern Sweden. In Lappland it may be considered as marking the stage between the nomad and the farmer. When a Lapp has grown poor by the loss of his reindeer, he will take to fishing and procure some goats,

this is the first step of his changing from a fishing-Lapp to a settler or resident farmer. The goat-milk is used either pure for making »goat-cheese», or mixed with cowmilk for imparting a sharper taste to the cheese.

The number of goats has been reduced more than any of our other domestic animals, in the period 1865—90 by one third. Of 87,000 in 1890 the larger proportion was found in Jemtland, viz 31,000, next to this in Dalecarlia 24,000 animals.

Swine.

In mediæval times swine were bred on a large scale at the extensive abbey-lands. The swine then would feed for a considerable part of the year in the vast oak and beech-forests that were valued in proportion to the number of swine to which they could afford nourishment.

The breed of swine then kept was the one still found amongst the peasantry in some places, viz the *native* swine, distinguished by a large and long head, long, drooping ears, high and strong legs, thin hams, coarse skin and bristles. It is very unpretentious, but it is not well adapted for the utilizing of dairy refuse, partly on account of its slow growth, and partly because it will not give the kind of pork required for the English market. However when crossed with the large English breed it gives an excellent pork that is considered even better than that of the pure-bred English animal. The English breed of swine most known in Sweden is the *large white Yorkshire* breed, of which several strains are found in the country; the other breeds have been given up.

In consequence of the development of dairy-farming, the swine show a larger increase of number than any other Swedish domestic animal, amounting for the period 1865—90 to 75 per cent. Of the whole number, 645,000 in 1891, more than $^1/_4$ were found in Skåne.

The import of live swine principally comes from Finland, while the main part of the export passes to Denmark. When calculated by the living weight of the animals the annual import of 1881—90 would amount to 540 tons, the export to 2,480 tons. Of the various years, 1887 attained the maximum of the import, viz 13,000 swine, 1884 the maximum of export, viz 50,000 swine. During the last years the export has been decreasing. Simultaneously with this, the export of pork has been increasing, while the import has decreased, as is shown by the following statistics, per annum, of the last two decades:

Period.	Import.		Export.	
	Kilog.	Lbs	Kilog.	Lbs
1871—80	10,342,000	22,804,000	170,000	375,000
1881—85	4,275.000	9,426,000	242,000	534,000
1886—90	3,603,000	7,945,000	2,288,000	5,045,000

Separate years, as 1889, would even show a considerable surplus of export.

The imported pork chiefly consists in cheap American varieties, and begins

to play an important part in the economy of the working classes. The export of pork has for a considerable length of time principally passed through Denmark as broker, but of late it has been shipped direct to England. Thus in 1891 England took 2,800,000 kg. (6,174,000 lbs) of the total export amounting to about 5 mill. kg. (11,000,000 lbs) and Denmark 2,200,000 kg. (4,850,000 lbs). Simultaneously with the development of pork breeding, private companies, principally located in our seaports, established pork butcheries on English models. In these, the business is regulated according to the wants of the English market and consequently the pork may be disposed of at first hand to England.

Poultry.

Poultry breeding as yet is not carried on in our country to the extent it well deserves, but still it is rapidly increasing. Thus in the last decades a great many henneries have been started in different parts of the country, and from these henneries breed-eggs of suitable strains, formerly wanting, are to be procured, together with information on rational poultry breeding. A similar kind of activity has been specially displayed by the »Association for improving poultry breeding». A great many breeds have been imported and are to be found in the country, but the opinion as to the Leghorn and Plymouth-Rock being the breeds most suitable to our conditions is steadily gaining ground. In 1891 about 190,000 score of eggs were imported to Sweden, of which the city of Stockholm consumed 163,000 score, while the export amounted to 923,000 score, of which the provinces of Malmöhus and Göteborg & Bohus furnished each one half. Norway is the chief consumer of Swedish eggs, and in the year above mentioned it absorbed one half of the total export.

Geese are principally bred in Skåne and Halland, although in consequence of changed conditions the large flocks of geese will nowadays not be seen so frequently as formerly. In 1880, about 18,000 live geese were exported from the provinces above-mentioned, and in 1890 their number was 9,000.

The tame duck is found in most parts of the country, though chiefly in Skåne. Turkeys are kept in many Swedish poultry yards, but in a number inferior even to that of the ducks.

The number of poultry, principally hens, geese and ducks, may be calculated to reach about 2,300,000 for the whole country. In this respect also, the southern provinces are better supplied than the northern ones.

Reindeer breeding.

The reindeer is the all in all of the nomad Lapp; it will furnish everything required for his subsistence. The reindeer is to be found in the northern parts of Sweden to about 63° southwards, at least along the Norwegian frontier. In the space between the latter and the Gulf of Bothnia the Lapps pursue their

annual migrations with the reindeer. During spring and early summer before going to the alps in midsummer time, and in autumn before commencing his wanderings towards the Gulf of Bothnia, the Lapp dwells in the so-called »autumn resorts», situated on the edge of the woods facing the alps, and he will remain in these places for a shorter or longer period, according to the quality of the reindeer pastures, consisting chiefly in reindeer moss which the reindeer seeks for in winter time by flinging away the snow. Thus the Lapp busies himself all the year round with watching his herd; the tent where he lives is called »kåta». In winter time the removals are effected on snow-skates, (»skidor») or in a sleigh of boat-shape, called »akja». The number of reindeer owned by a Lapp varies to a considerable degree. The poor may have 50—200 reindeer, those better off 300—700, and the rich Lapps will keep 1,000 and even 5,000 reindeer.

When a reindeer is killed, every bit of it is utilized. The meat, blood and bowels are used for food, the skin is made into clothes and shoes, the sinews will furnish materials for thread, the bones and antlers are made into handles, etc.

When the reindeer is going to be milked, the herd is driven together and the reindeer-cows are caught and bound. The period of milking lasts from June to October, and during this time every cow will give from 0·2—0·5 liter ($^1/_5$—$^1/_2$ quart) of milk, when milked twice a day. The milk is thick and rich, »like sweet cream», but the taste resembles that of goat-milk. It is seldom used when fresh, but will commonly be kept for cheese-making or for curdled milk; sometimes it is left to freeze, or mingled with berries, or diluted with water for drinking, etc.

Cured reindeer meat, skins and cheese are the products at the disposal of the Lapps to exchange for other necessaries.

Certain Lapps, called the »forest-Lapps», will not bring their reindeer to the alps, but remain with them in the forest-belt all the year round, though they will move about with the reindeer in the same way as the »alp-Lapps». Besides, the »forest-Lapps» will leave their reindeer to themselves during spring and autumn, and then have leisure to busy themselves with hunting and fishing.

There is some difficulty in collecting statistics on the number of reindeer, as the Lapps may sometimes be unwilling or unable to give any correct statements. According to the statistics of 1890 the number of reindeer in Sweden would amount to 296,220, of which 52,550 were in the province of Jemtland, 40,500 in the province of Vesterbotten, and 203,170 in the province of Norrbotten.

Wild Animals.

Owing to the increased cultivation of the soil, the number of the larger *beasts of prey* has diminished, though they still do a vast amount of damage, so that their extermination is a necessity, more especially in the northern part of Sweden, where the flocks of reindeer belonging to the Lapps, and also other cattle, are often attacked by bears, wolves, and gluttons. The bear is limited to

Norrland, Dalecarlia, and Vermland; the wolf and the glutton are only to be found in the extreme North, though, during very severe winters, the former sometimes extends its range southwards. The lynx chiefly inhabits Central Sweden and is a fatal enemy both to sheep and goats, and also to game. The fox is common over the whole country, and in consequence of being very numerous, doubtless does as much harm as the larger beasts of prey.

The havoc yearly occasioned among domestic animals by these enemies of theirs is calculated as amounting to about $ 30,000. To obviate this evil in some degree, bounties are paid both by the State, Agricultural Societies, and private associations. From 1886 to 1890 these bounties amounted to $ 12,000 a year.

The number of beasts of prey annually killed was:

Period.	Bears.	Wolves.	Lynxes.	Gluttons.	Foxes.
1856—60	127	174	174	122	10,465
1861—65	106	111	136	109	13,920
1866—70	99	47	105	139	12,641
1871—75	52	46	107	101	8,193
1876—80	60	37	67	129	11,750
1881—85	32	34	26	119	15,310
1886—90	33	29	20	89	15,342

During latest period mentioned 15,000 birds of prey were also killed.

Laws concerning *useful game* were published at an early date in Sweden, indeed the first Game Laws were issued in 1647. Those at present valid date from 1864, and prescribe a close time for all those animals whose exemption from extermination may be considered of weight for the nation.

The most important of these animals is the elk, which is chiefly found in the wooded tracts of Central Sweden, and of late years has considerably increased in number. Stags are only found in circumscribed tracts of Southern Sweden, whereas roedeer occur as far north as Östergötland. The wild reindeer is met with, though not to any great extent, up in the fell districts, but is not largely hunted. The hare, as does its arch-enemy the fox, abounds over the whole kingdom.

Among *game birds*, the capercailzie, blackcock, and hazel-grouse are eagerly sought for, large quantities being sent from Norrland to places lying south, more especially to Stockholm. The ptarmigan is proper to the north of Sweden and the partridge to the southern half of the kingdom. *Seafowl* are eagerly sought for on the coasts, chiefly for the sake of their feathers. The eider, one of its noblest representatives, has now, in consequence of being protected by law, yearly increased in numbers.

The preservation of game is greatly aided and encouraged by a large number of Sporting Clubs and similar associations, spread over the whole country. There being no figures concerning proceeds of game killed, it is impossible to state any decided sum, but it must represent a very large amount of money.

DEPARTMENT D.

FISH, FISHERIES, FISH PRODUCTS AND FISHING APPARATUS*.

Fisheries cannot at present be considered as among Sweden's most important industries, but they are doubtlessly capable of further extension, and for the coast population they already are the most important avocation. Out of the whole population about 50,000 may be said to depend directly on fisheries for their support, and, besides, fishing is a noteworthy help for a considerable number of other people, both on the sea coast, and along the shores of the innumerable lakes of the country.

The *value of the catch*, on the spot, may, at the time of writing, be calculated at between $ 3,000,000—$ 4,000,000 annually. The following figures are given, illustrative of the annual *imports* and *exports*.

Period.	Imports.	Exports.
1876—80	$ 2,202,000	$ 139,000
1881—85	1,794,000	687,000
1886—90	1,479,000	2,908,000
1891	1,946,000	4,587,000

From the above figures it is seen that, during the last year, the exports exceeded the imports by more than $ 2,500,000. For quantities exported see page 96.

The herring fishery, including strömming or Baltic herring, is at present the most important branch of the industry, after which comes the catch of salmon, eels, etc. and fresh water fish. Cod, mackerel, etc., are taken off the West Coast, and oyster and lobster fisheries have also some importance.

Of *industries in connection* with the fisheries, can be mentioned herring salting and preparation of anchovies, preserving salmon, etc. Much of the herring catch is used as fodder and also as manure.

Fish and other forms of Aquatic Life.

In a zoogeographical point of view, Sweden belongs to the Palæarctic region, extending in its northern divisions above the Arctic Circle, while in the extreme

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south the climatic conditions are those of northern Germany. The great length of the country, extending through no less than 14 degrees of latitude, together with the different nature of the waters surrounding it on the east and west, naturally produce strongly marked variations, both as regards fish and other forms of water life.

The waters of the West Coast, with a larger percentage of salt in consequence of their connexion with the North Sea, possess fauna and flora more important than those of the Baltic, and its arm, the Gulf of Bothnia, on the East. The division between these waters is very sharply defined, and is situated at about the middle of the Sound. In consequence of the lesser saltness in the Baltic, there exist, especially in the archipelago, many species of fish and of lower forms of water life belonging to fresh water, and occasion in the animal life of the Baltic a characteristic blending of salt and fresh water fauna, partly consisting of survivals from the ice period. The total number of fish species existing in Swedish waters, amounts, as far as is at present known, to between 160 and 170 (according to the method of classification), of which, however, a not inconsiderable number must be reckoned as rare visitors to our coasts, and comparatively few have a direct economical value.

Of edible molluscs and cray-fish, the *Oyster* (Ostræa edulis) is found as far south as Marstrand, other edible species, such as the *Mussel* (Mytilus edulis) and the *Whelk* (Buccinum undatum), are used amongst us simply as bait, and not as an article of food. The *Lobster* (Homarus vulgaris) and the *Crab* (Cancer pagurus) are found on the West Coast as far down as Kullen, the *Prawn* (Palæmon squilla and Fabricii) and the *Shrimp* — this latter used solely for bait — are also found in the Sound and the southern Baltic. The *Crayfish* (Astacus fluviatilis) is found as far north as Medelpad.

Amongst water mammalia, we have many of the larger and of several smaller species of *Whale*, but these nowhere form the object of any special fishery. We have three species of *Seal*, the Common Seal (Phoca vitulina), the Ringed or Marbled Seal (Ph. foetida) and the Grey Seal (Halichærus gryphus). Some are shot, others are caught by means of nets, traps and falls. Seal shooting on the ice is carried on to a considerable extent in the Gulf of Bothnia and the northern Baltic, but has latterly greatly fallen off on account of the low price of seal oil.

Deep Sea Fishery.

Besides the varying saltness of seas, the conditions of the coasts have also an important bearing on the fisheries of Sweden. With the exception of the sea borders of Halland, Skåne, the islands Öland and Gotland (and partly also of Blekinge), our coast is more or less deeply indented by bays, and is girdled by a belt, varying in compactness, of islands, rocks and cliffs, which is termed the »skärgård». The seas surrounding our coasts are not remarkable for any great

depth. Along the southern coast of Norway extends from the Skagerack down to Bohus Bay, the deep »Norwegian Channel», with a depth varying between 400 and 600 metres (1,300 to 2,000 feet), decreasing to 100 metres (330 feet) towards the coast of Bohuslän. To the south, and close to the west coast of Sweden, abruptly descends a somewhat deeper channel in the Cattegat, which otherwise is very shallow, with favourable fishing grounds. Great part of the Sound can also be considered as a similar fishing bank. The Baltic is on the whole a shallow inland sea, but still deeper and less favourable for fishing than the North Sea, and the fishing grounds are situated nearer the coast among the archipelagos. These coast features have doubtlessly contributed to give to our fisheries the form of coast fishing, wherever the archipelago exists. Certainly, off Bohuslän, deep sea fishery is carried on, but with the exception of some mackerel fishery in the summer with drift nets, in Bohus Bay, and the so called bankfishery which is carried on in the Skagerack (at Jutland reef) and in many places off the Norwegian coast, and along the slope of the »Norwegian Channel» as far up as Bergen, open sea fishery is pursued only off the above named stretches of unsheltered coast and principally in the form of drift-net fishing for herring on the most southern coasts of Bohus, Halland, Skåne and Blekinge, of Gotland and part of Öland, — and with hook and set-nets for flounder, cod, etc. in Bohus Bay and the Cattegat.

Herring Fishery. The most important undoubtedly of our sea fisheries are those of the herring and the »strömming» (name of the herring caught along the Baltic coast from Kalmar northwards) which on different parts of our coast are carried on nearly all the year round. The Bohuslän herring fishery is the most prominent and continues from October or November till the end of the next February or March. This fishery is remarkable from the fact, that within recorded knowledge, the herring have periodically appeared in vast shoals, and then again, at intervals of more or less duration, almost deserted the coast, or rather, the herring fishing there has been reduced to the comparatively unimportant stock of fish always remaining on the coast. The »herring-period» now existing in Bohuslän, commenced in 1877, the one previous lasted from the middle of the last century until 1808. The herring shoals, which during these periods visit the coast of Bohuslän, come from the North Sea, and their non-appearance depends probably on hydrographical causes, at present not well understood.

The Bohuslän herring fishery is carried on partly with seines (»sättgarn»), partly by stationary nets (»vadar»), and to some extent, by means of purse seines, and gave a catch during the season 1891—92 of 1,632,000 hectolitres, with a value, on the spot, of $ 603,000. On the southern coast of Bohuslän and of Halland, is carried on a lesser but remunerative herring fishery, by means of drift-nets (»drifgarn»), from early autumn in the middle of August till the beginning of October, the herring spawning season in the Cattegat being during the months of September and October. The value of the Bohus län drift-net fishery amounted in 1891 to about $ 26,000, and that of Halland in the same year to $ 18,000. It

is, however, to be noted, that the latter province had an uncommonly bad season. In this fishery the fishermen of Skåne also participate, whose grounds, during the remainder of the year, are in the southern Cattegat and the Sound.

During the middle ages, the last named water was the seat of the fishery, named from two towns, the Skanör—Falsterbo», and the herring fishery at that place, was in its day the richest and most important in North European waters, before the occupation reached its present large dimensions. In the southern division of the Sound, the herring shoals enter as well from the Cattegat, as also, and principally, from the southern Baltic, and are here caught both with drift and stationary nets, from the end of August, till the middle or end of October. Fishermen from Blekinge and the east coast of Skåne also take part in that fishery. In the southern Baltic, around Bornholm and down to the German coast, as well as around Gotland, far out in the sea, drift-net fishery is carried on from spring till late in the autumn, by fishermen from Blekinge, Skåne and Gotland.

From the commencement of the archipelago, off the coast of East Blekinge, and all along the coast to the borders of Finland in the north, the *Baltic-herring* (»strömming») fishery is pursued, with seines, herring nets, and very occasionally with a kind of large trap (»ryssjor»), off or close to the coast, and off the outer islands and channels of the archipelago. The value of the herring fishery amounted in 1891, for the province of Malmöhus to about $ 180,000, for Blekinge and Gotland respectively in the same year to $ 80,000 and $ 54,000. There are but irregular accounts for the other coast districts during the same year; thus for the province of Vesternorrland the amount was $ 80,000. On the whole the amount may be given in round numbers at more than $ 800,000, as the value of the Baltic-herring fishery.

Another of the herring family is also caught, the *Sprat* (Clupea sprattus), and principally on the coast of Bohuslän, but also in a lesser degree, off various places along the Baltic shore. Sprats derive a great importance as forming the material of the »anchovy» industry of Bohuslän. The genuine anchovy is but seldom met with on Swedish coasts.

The *bank fishery* of Bohuslän, previously mentioned, is chiefly carried on for ling cod, coal-fish, haddock, halibut and mackerel, etc., by means of long lines from large decked fishing vessels (the so called »bank-sloops», having crews of 12 or 14 men), and also nowadays from cutter rigged fishing smacks of English model. During the fishery the vessels are anchored on the before mentioned fishing grounds in the North Sea and the Skagerack. The fishing is carried on at great depths (600 to 1300 feet) and not on the »banks» as might be supposed from the name. In 1891 the number of vessels employed was 167 and of men 1,389. The value of the fishery was about $ 145,000.

The Mackerel (Scomber scombrus) although found as far south as the Sound, is the object of any noteworthy fishery only off Bohuslän and a part of Halland. It is carried on with the drift net and the hook (»dörj»), occasionally with

the seine, from May till September, and in 1891 gave a return of more than S 100,000.

The *Cod* (Gadus morrhua) is found on our coasts as far up as the Gulf of Bothnia, but does not give occasion for any important fishery; still it has, for our conditions, no inconsiderable worth, although the value cannot at present be given with any absolute accuracy.

Of the flounder fishing the same may be said: in the middle and southern Baltic are caught only the common *Flounder* (Pleuronectes flesus) and the *Turbot* (Bothus rhombus) and in the southern Baltic, the *Plaice* (Platessa vulgaris) which, together with the *Sole* (Solea vulgaris), has formed of late the object of a very remunerative fishery in the Cattegat by Skåne fishermen, with well-smacks (»kvasar»). The *Halibut* (Hippoglossus maximus) is fished only off Bohuslän, the remainder of the flounder family, as the *Brill*, the common *Dab*, the long rough Dab, etc., being of no essential importance for our fisheries.

Of the species of fish, which frequent both salt and fresh water, the *Salmon* and the *Eel* are also, on the sea coast, objects of a very profitable industry. Both off, and in the immediate neighbourhood of the mouths of salmon rivers, both on the western and especially on the eastern coast of the country, salmon fishery is carried on by the fishermen of Skåne, Blekinge and Gotland, using salmon drift-nets (»lax-drifgarn») and floating lines in the open Baltic, during the spring and late autumn. Eel-fishery is carried on in the autumn from August till November, for the fish which then makes its way along the Baltic coast out through the Sound. This eel-fishery, which is carried on by means of a kind of bow-net (»hommor»), is particularly remunerative in Blekinge and on the eastern coast of Skåne. In the inner bays of the Baltic, and amid the islands of the archipelagos, are found a great number of actual fresh water species of fish, amongst which the *whitefish* specially deserves mention as an object of a rather remunerative fishery in the North.

The chief fisheries of *Lobster* and *Oyster* are found in Bohuslän, and the value for each amounted in 1891 to S 36,000. The *Crab* and the *Prawn* are also caught along the west coast and in the Sound; the latter is reserved chiefly for the Copenhagen market.

Fresh water Fishing and Angling.

Sweden possesses a multitude of large and small lakes occupying in this regard, and proportionately to its area, the second place amongst European countries. The number of rivers, large and small, is also very great. The total number of *salmon rivers* is about 40, having an aggregate length of 9,000 kilom. (5,600 miles), of which 3,700 kilom. (2,300 miles) are accessible to salmon. Our largest salmon streams are the rivers Torne, Kalix, Lule, Ångerman, Indal, Ljusnan, the Dal, Klar (with its continuation the River Göta), the Lagan, Nissan, Ätran and Viskan in

Halland and the Mörrum in Blekinge. Salmon fishery is also carried on in Lakes Venern, Vettern, Siljan and Storsjön, etc. Accurate figures are still wanting, but the value of the salmon fishery may be taken at present, as amounting to at least $ 270,000 annually. The season is from the beginning of May till the end of August, or, in some rivers, the first days of September. In northern rivers the fish first ascend the stream in the month of June, and, as a rule, July is the best fishing time in our rivers. From the month of September till the ensuing spring is the general close time for salmon; the fish spawn during October and November.

Besides the Sea-salmon (Salmo salar), our authorities distinguish the Gray Salmon or *Lake trout* (S. trutta) and the *Salmon trout*, or common trout (S. fario). Many of our largest salmon fisheries belong to the state and are leased on its account. The other fisheries belong to the shore-owners.

Other species of fish deserving mention are the *Charr* (Salmo alpinus), and the *Grayling* (Thymallus vulgaris), which are found principally in the northern districts of the country, the last named fish being also caught in the Gulf of Bothnia. There are also species of *White-fish* (Coregonus), Gwyniad and Vendace (C. lavaretus and albula), which are found in considerable numbers in many of our lakes and are of great importance in our fisheries. The *Smelt* may also be named.

Other fresh water species most generally found, and of great importance to Swedish fisheries, are the *Pike* (Esox lucius), *Perch* (Perca fluviatilis), *Pike-perch*, or *Zander* (Lucioperca sandra), *Bream* (Abramis brama) and many more of that genus; the *Chub*, *Tench*, and *Roach* and other Cyprinides; — the *Burbot*, the *Eel* and *Lamprey*.

Amongst the more peculiar fishing apparatus, deserve to be mentioned the large constructions of poles and nets, or piles with plaited twigs, or the staked gateways sometimes used for catching salmon in our northern rivers. These crawls are called »pator» (Finnish »pata»), and in them, hundreds, and when the fishing is good, thousands of salmon are every day caught in the River Torne. In other respects, our fishing apparatus presents no striking differences from the ordinary forms.

Angling for Salmon and Trout, as a sport, is pursued on a very small scale in our streams and then mostly by foreign tourists. As a sport, fly-fishing is, on the whole, but poorly developed in our country except in the rivers of Halland. Our great northern rivers have shown themselves less suited for the purpose.

As an industry, fresh water fishery at the present day plays a very important part, and fresh water fish enters largely into the daily food of the poorer part of the population.

Amongst other fresh water animals we have only the *Cray-fish*, which is found acclimatized as far up as Medelpad. Its northern limit in this country is, however, in Dalarne and Gestrikland. In certain districts it is found in great numbers. The produce of this fishery is chiefly for home consumption, but a

not altogether unsuccessful attempt has lately been made to supply the German market (Berlin).

Pearl Fishery. Fishing for the pearl mussel, found in some of our rivers, is pursued in many of these, but to a small extent, and is of no great importance. It was formerly a Crown right, but there are now no restrictions.

Products of Fisheries.

Simultaneously with the expansion of the network of railroads and of the development of communication in general, the sale in distant markets, of fresh fish packed in ice, has been on a continuous increase. In 1891–92, close upon 19 million kilog. (370,000 cwts) fresh herring was sent by rail from Bohuslän into the interior of the country. Our chief customers abroad are Germany and England (to which country the export partly goes through Norway), Denmark, Holland, etc.

The export of *fresh herring* from Bohuslän amounted in 1891—92 to 54 million kilog. (1,060,000 cwts). But the salting of herring has also considerably increased, especially since the introduction of the Scotch method, which is now used as well as the Norwegian method previously employed. During the season 1891—92 there were salted in Bohuslän, 418,000 barrels of herring, of which a not inconsiderable amount was the product of Norwegian fisheries. The Bohuslän fishery has shown itself capable of competing with the Scotch supply in the German markets, which together with the Baltic provinces are the chief importers. The *Baltic-herring* or strömming is also salted, but nowadays exclusively for the home markets, especially those of northern and middle Sweden. Yet the strömming is also disposed of in the fresh state. The imports of Stockholm alone, from the adjacent archipelago, amount to about $ 54,000 annually. The herring harvest of southern Sweden is disposed of, almost exclusively, in a fresh state, partly in the home markets and partly in Denmark (Copenhagen) and Germany.

In lesser quantities, Baltic-herring is preserved as a delicacy (»kryddsill») which is consumed within the country. Sprats preserved in oil, with spice, or in various sauces and sold under the name of anchovies, form a very important industry of Bohuslän and are extensively consumed, as well in Sweden as abroad; they are sent far and wide, packed either in wooden casks, or, as is chiefly the case, in small tins.

The products of the before mentioned bank fishery, is principally prepared into *dried fish* (»spillånga») so named from ling being dried through stretching on strips of wood, — but also as *dry salted cod* (»kabeljo») which is chiefly disposed of in the home markets.

Mackerel is partly home consumed, partly exported to Norway and Denmark. Supplies of salted mackerel have also lately been exported to America, either direetly, or by way of Norway. The greater part of the produce of the Salmon fishery is nowadays sold in a fresh condition, packed in ice, but the salted fish

is also an article of considerable trading importance, both fresh and salted salmon being exported, chiefly to Germany and England.

The product of the important eel-fishery of the southwestern coast is taken principally by the German market (Berlin) and bought on the spot by German well-smacks stationed on the coast.

The *smoked fish industry* is pursued in this country on a comparatively small scale, the use by our people of smoked fish not being so extensive as that of our continental neighbours. The smoked fish is chiefly salmon, of which the best is prepared in Halland, under the name of »Halmstad salmon», and is much valued as a delicacy. Herring and strömming are warm-smoked, as are both eel and lamprey. Smoked mackerel is also relished, as also is salmon in oil (canned). A preparation of salmon which is peculiar to this country is »graflax» (sw. grafva = to dig a grave), or salmon which, after having been lightly salted and pressed for two or three days in a cool room or buried in the earth, is eaten in a raw state. The peasantry prepare gwyniad, vendace, and many other kinds of fish in the same way.

The *export of fish* is on the increase as may be seen from the appended official figures, in metric tons:

Year.	Fresh fish of all kinds.	Salted or otherwise prepared herring.	All other kinds.
1887	34,098	2,598	325
1888	38,251	5,526	877
1889	55,783	20,517	664
1890	68,291	22,701	865
1891	67,863	31,238	848

A consequence of the great increase in the fishing industry in Bohuslän has been the establishment of many large factories for the preparation of fish *by-products,* — guano and fish oil.

Fish Culture.

In the question of the cultivation of summer-spawning fresh water fish, Sweden has been its originator, inasmuch, as far as is known, the first attempt in that direction was made by the then alderman and afterwards mayor of Linköping (in Östergötland), C. I. Lund, who introduced heavy perch and bream, etc. into wooden tanks (»sumpar») of his own construction, where they deposited their spawn on a layer of twigs, after which the parent fish was taken out and the spawn fructified on the twigs was protected during the process of hatching. This method was described by him in the »Proceedings of the Royal Academy of Sciences» in 1761, but nothing further was done after these experiments. When the artificial cultivation of salmon and trout-spawn again revived, in the decade 1840—50, some lesser experiments were made, also in Sweden, but it was first

after the Government in 1865 had erected in the Ångerman River, a special *salmon hatchery* where instruction in fish cultivation was given, that the matter made progress. Since that time, many fish hatchery establishments have been erected, and old ones abandoned, and 50 to 60 hatcheries are now found in most of our salmon rivers. The greater number are built of wood, and have wooden tanks, but there are also newer constructions in many places, from which a considerable number of fry has been introduced into our streams in the course of years.

The introduction of new, although native species of fish into various rivers, where they were formerly not to be found, has been pursued in many places with success. The attempt to acclimatize foreign fish has been made but once, in the case of the American black bass imported from Germany; the result in Sweden is yet unknown.

A magnificent erection was founded in 1879 in Gustafsborg, Skåne, for the breeding of carp. Nowadays, carp is hatched with success, as far north as the iron works of Långbanshyttan in Vermland in 59° 45′ N. latitude. At Finspång, in Östergötland, there has been built, at the expense of the Government, a smaller fish hatchery, in connection with a Freshwater Biological Laboratory. Courses of instruction in fish culture and fishing have been frequently given for the training of fish cultivators and overseers of fisheries.

Legislature on and **Administration** of the Swedish Fisheries. Legislature concerning fish-economics is of comparatively late date in this country, and our first general enactment for the fisheries is dated 1766, — that now in operation, dating from June 29th 1852. Legislature for special fishing districts are made by the governors of the provinces, after requesting the opinion of the Chief Inspector of Fisheries to the Royal Board of Agriculture, in whose jurisdiction at present all the fisheries lie, excepting the sea fisheries of the west coast (Bohuslän and Halland). These latter lie under the direct supervision of the governors in the provinces of Göteborg & Bohus and of Halland, and are managed by overseers nominated by them. Under the Board of Agriculture, the work is performed by a staff of two fishery assistants, one instructor of fish breeding, and one stipendiat, who partly make researches regarding the fishing grounds and fisheries, and partly supply private persons, who may desire it, with information and advice concerning fishing and fish culture. Besides there are, in many provinces, overseers, of whom some are state paid, and others receive grants from the Agricultural Societies. These are subordinate to the Board of Agriculture and the above mentioned officials connected with the Swedish fisheries.

DEPARTMENT E.

MINES, MINING, AND METALLURGY.

Mining*.

Mining Laws. a) *Ores.* According to the law of May 16:th 1884 every Swedish citizen is entitled to claim all mineral deposits containing:

1) the ores of gold, silver, platinum, mercury, lead, copper, iron, with the exception of lake and bog ores, manganese, chromium, cobalt, nickel, zinc, tin, titanium, tungsten, molybdenum, bismuth, antimony, and arsenic;

2) iron pyrites, magnetic pyrites and graphite,

provided, in all cases, that the minerals are to be found at a distance of not less than 200 metres (656 ft) from dwelling houses, building ground or garden.

A claimholder is authorized to explore the ground holding the mineral deposit within a radius of 100 metres (328 ft). The landowner is entitled to partake in the working of the mine to the extent of a half and to equally share the profit.

When the deposit is laid open, a certain area of 200 metres in length and breadth is assigned, within which the owner of the mine has exclusive right to work. The boundaries of this area extend downward vertically. A certain amount of work is to be done yearly on the said area; if not, the rights are forfeited and the deposit then may be subject to a new claim.

b) *Coal deposits* are not subject to a claim. For the right of working this class of deposits, a concession from the king has to be obtained. The concession may extend over an area of 1,600 hectares (about 4,000 acres). The boundaries extend downward vertically. The holder of a concession has every year to pay a certain royalty to the landowner and, besides this, is bound to do a certain amount of work.

Occurrence of ore and coal deposits. The Swedish ores lie as a rule in the *Primitive* or *Archæan* formation, chiefly in its later division. Here occur the principal iron-, copper-, lead- and zinc ores as well as ores of other kinds. To the Jurassic formation or rather to the link between the Jura and the

* By Professor G. NORDENSTRÖM.

Trias, called the Rhætian formation, belong the fossil coals occurring in Skåne. Finally there are to be mentioned those quarternary formations which occur in a great number of the provinces of Sweden, viz: *Lake* and *Bog ores.*

Amongst the ore deposits the *Iron ores* are the most common and occur in the greatest quantity. They consist generally of *Magnetic iron ores*, but partly also of *Hæmatite* or *Specular ore.*

Taking the present production of these two kinds of ore, we find about 77 per cent of magnetites and 23 per cent of hæmatites of the whole production of rock ore. These two ores, which often distinguish themselves by their great freedom from phosphorus, sulphur and other deteriorating substances, are commonly called *Rock Ores*, and form as a rule lenticular beds in gneiss, granite, felsite-schist, micaschist and primitive limestone. Iron ore may exceptionally occur in floors in hyperite, as for example at *Taberg* in Småland, where exists a mountain of iron ore of 120 metres in height, 900 metres in length and 450 metres in breadth (resp. 400, 2,950 and 1,475 ft). This ore contains only about 32 per cent of iron, while other iron ores contain from 50 to 60 per cent and more.

The greatest quantity of Sweden's best iron ores and, at the same time, those that have been worked the longest, occur, compared with the total area of the country, within rather a small space, or within a belt of an area of 15,000 sq. kilom. (5,800 sq. miles), which belt extends from the Gulf of Bothnia on the east, to the district north of lake Venern on the west. Southward this ore region continues to the middle part of the province of Östergötland, and northward, to the northern border of the province of Dalecarlia. Here occur farthest to the east the Dannemora field, of worldwide fame for its ores, free from phosphorus, and in many other respects unique, and in about the middle of this district are situated the Norberg, Bispberg, Grängesberg, Striberg, Stripa and several other extensive mining fields, and farthest to the west the Persberg ones and some others.

North of this ore district are found some considerable iron ore deposits, but only as far north as in the vicinity of the polar circle. Here are situated the iron ore deposits of Gellivara, Kirunavara and Luossavara, in length of strike, thickness and percentage of iron the principal iron ores of Sweden.

Some of these iron ores just mentioned belong to the largest and richest in the world. Thus a horizontal section through the nearly vertical mass of ore at Kirunavara and Luossavara represents an area of 500,000 sq. metres (5,384,000 sq. ft); all the ores at Gellivara have in their outcropping an area of about 250,000 sq. metres (2,690,000 sq. ft). At Ruotivara the area is estimated at nearly 300,000 sq. metres (3,230,000 sq. ft), etc. When besides this we consider, that the average percentage of iron at several of the mines in these mining districts amounts to 60—65 and more, it is evident that mining here might be pursued on a grand scale. Up to lately, however, all these important iron ore deposits have been lying idle, partly on account of bad communications, partly owing to the high percentage of phosphorus (at Gellivara and Kirunavara) and titanium (at

Ruotivara). Owing to the want of communications there is no mining at any of these fields, with the exception of the Gellivara field, at which energetical work has been going on from the year a railroad connection with Luleå harbor was completed. During the year 1892 there were about 135,000 metric tons mined and exported.

Lake and *Bog ores* occur and are worked in several provinces, chiefly in Småland; the production of these ores, however, has, during the last decennium, decreased considerably.

In Sweden exist, besides iron ore, many other metalliferous minerals as *zinc*, *copper*, *silver*, and *lead ores*, *manganese*, *cobalt* and *nickel ores*, *graphite* and *pyrites*. The rare minerals *cerite* and *allanite* are also to be found in quantities worth mining, as well as native *gold* of which the largest quantities at present are found in Falu coppermine.

Most of these ores are found and mined within the same territory or belt, as that of the iron ores mentioned above. None of these ores, however, is mined in a quantity to be compared with that of iron ore.

The principal mining field containing *zinc* is that of Ånmeberg, owned by the company »La Vieille Montagne». The largest *copper* mine is Falu mine, worked from the earliest times and known by miners of all countries. The principal *silver* mine is Sala, which also was worked several centuries ago.

Prospecting. To find iron ores and to form an idea about their extension and position the miner's compass has been used in Sweden as early as 200 years ago. It is also used in the prospecting for other ores than iron ore, these ores being impregnated more or less with magnetite or magnetic pyrites, and therefore the miner's compass is used for the discovery of zinc-, lead- and silver ores. For magnetical surveying of the ore fields *Thalén's Magnetometer* and *Tiberg's inclinatory needle* have been in use during the last decennium to the greatest advantage. By the »magnetical» maps of the mine fields, drawn according to surveying with these instruments, it has been possible to accomplish a much more complete and exact history of the magnetical conditions, than by the compass alone.

At the examination of ore deposits the *diamond drill* has lately come into extensive use. The *Crælius* drill, mostly in use, is run by hand-power as well as by petroleum motors. With this drill borings have been made to the depth of nearly 138 metres (457 ft). Sometimes even larger diamond drills run by steam or compressed air, are made use of. During the years 1887—91 examinations were carried out in this way to a total depth of about 10,800 metres (35,000 ft).

Boring-tools and Explosives. The boring-tools, including borers and sledges, in use at the Swedish mining fields, are manufactured from Swedish steel of the highest quality. By long practical experience and by the most careful experiments the form and weight of these tools have been adapted to the ores and rocks often extremely hard. The mallets for single-handed boring, which

method of boring is now exclusively in use, weigh about 3·5 kilog. (7·7 lbs), while the borer's average weight is 1·4 to 1·7 kilog. Owing to this relation between the weights, as well as to the practical shape of the tools, it is possible to utilize from 66 to 74 per cent of a man's work at boring.

Boring machines or **Rockdrills** are also used in several places, both for level and for sinking work, for overhand stoping, and for crossworking, but as a rule never for underhand stoping. The drills in use are those of SCHRAM's and RAND's construction, the latter with some excellent modifications. These machines are run by compressed air at a pressure of about 2·5 atmospheres, their effect being in general twice to two and a half times that obtained by hand-boring. In erecting the boring machines simple columns of the common form are used, and for the fastening of the machines to these columns a screw-clamp of C. Bekk's pattern is employed, this clamp having proved to be the most practical for the purpose.

Of *explosives*, »extra dynamite» and ammoniacal powder are chiefly in use, but »sebastine» is also made use of.

Opening and forewinning works (Shaft and Gallery.) The shafts of the Swedish mines have in general an area of 18 to 20 square metres (4·5 × 4 m. and 4 × 5 m. dimensions) or about 200 sq. feet, with separate divisions for the hoisting, for pumps and »ladder-ways», and for lowering refilling, materials etc. In consequence of the hardness of the Swedish rocks no other buildings are as a rule wanted in the shafts, than those for raising ore and water and for ladder-ways. The cost of sinking shafts is consequently a great deal less, than in several other countries. Per meter shaft in average 40 to 70 metres are bored and 6—10 kilog. extradynamite used in hand-boring. The cost per metre of sinking vertical shafts, with necessary buildings for hoists, pumps and ladder-ways, amounts to $ 55 à 80.

The dimensions of *levels* are in general 1·5 × 2·2 to 2·4 × 2·5 metres. Driven *by hand* these levels require boring of 12 to 20 metres per running metre, and 2 to 4 kilog. (4·4 to 8·8 lbs) of explosives. The prices per running metre for level work vary in general between $ 8 and 13, the miner paying for the explosives, tools and other materials.

Methods of mining. a) *Ore mines.* Owing to the hardness of the ores and their gangues, the method of *underhand stoping without filling* is still most often used. About 80 per cent of all iron ore obtained are mined by this method. But even methods of replacement are used for such ores, as have a tendency to cave in as well as for the mining of ores of great thickness. Thus for the profitable mining of ores of this kind *overhand stoping* and *crossworking* are used. Whatever be the method used, it is always preceded by preparatory works of driving levels and sinking, in accordance with a plan of working formed beforehand.

During the taking out of the known ore supply, work is simultaneously carried on to discover new supplies. In this way, and by limiting the output of ore, and adjusting it to the existing ore area, the original value of the mines is generally for a long time kept up.

The quantity of ore and rock won by the blasting varies according to the mining method, the kind of ore and of the gangues etc. At overhand stoping and cross-working this result might, however, be estimated to about 10 to 15 tons per kilog. explosive.

b) *Coal mines.* The coal beds lie as a rule horizontally or have an inclination of but a few degrees, and contain, besides coal, coalshists in varying quantities; the underlying beds consisting of clay, generally refractory. The roof of the coal bed consists of sandstone. The common method of mining is a combination of *post- and stall work with longwall*, longwall working alone, however, sometimes being used.

The proper preparatory works having been completed, the work of cutting the coal is begun, preceded, however, by an undercutting, for which purpose a double-pointed pick is used, of 0·6 metre in length and weighing 1·10 kilog. (2·4 lbs). A sufficiently deep undercutting having been made, the upper part is wedged down, and the remainder is cut down with single-pointed picks, somewhat heavier than those used for undercutting.

Hoisting of rock and water. a) *Ore mines.* The greatest depths to which the mines of Sweden have been worked do not reach much beyond 300 metres (1,000 ft) for iron mines and 400 metres (1,300 ft) for mines of other kinds. Considering that as a rule there are no particularly large quantities of either minerals or water to hoist, it is evident that the machines for this work need not in general be of any considerable power, and for that reason the raising arrangements have not a very great capacity. But while formerly the larger machines were at the most of 20 to 30 horsepower, they now vary between 80 and 90.

The modern shafts for hoisting are as a rule perpendicular and divided as before stated. The hoisting is made in cages, the guides of which consist either of wooden slantways, or wire ropes. The hoists are in general provided with safety catches. In older inclined shafts the raising is accomplished by cages, or skips on wheels running on rails. The hoisting speed varies in general between 1 and 2 metres per second.

In the ore mines there is generally no large quantity of water. It varies between 0·25 and 1 hectol. (65 to 260 gall.) per minute. In some mines it amounts to only 0·13 hectol., while the largest figures are 3 or 4·5 hectol. per minute. For draining deep mines plunger-pumps are used, the diameter of the plunge being 0·15 to 0·2 metre and the stroke 1·5 metre. The height of pressure, never less than 70 to 80 metres (230 à 260 ft), is sometimes 200 to 220 metres. For small mines, suction- and lifting-pumps are used.

b) *Coal mines.* The hoisting machines in coal mines have considerably more power than those used in ore mines. The weight of coal and clay here raised per day is even considerably greater than in the ore mines. The quantity of water is also many times larger. In less wet mines it amounts to about 15 hectol. per minute, but in those abounding in water it reaches the amount of 50 hectol. per

minute. All the shafts for raising are perpendicular. Their greatest depth is about 100 metres (330 ft). The raising of coal and clay is accomplished by cages guided by wooden or wirerope guides. Safety apparatuses are not used.

Ventilation and Lighting. Observations made at several Swedish mines have proved that the temperature in a mine increases 1° Celsius for every 50 metres (165 ft). Accordingly the temperature in the deepest mines is + 11° to + 13° and in those of common depth + 6° to + 9°. The average temperature on the ground varying between + 3·7° and 5 or 6° a natural *ventilation* is caused, which is quite sufficient for most of the mines. Artificial ventilation is consequently required only in such places, which are narrow and far from the shafts. In these cases the Harz' ventilator is in general use, but fans are also used.

In the coal mines the natural ventilation contributes to a great extent to carry away the foul air, but it has to be aided by artificial means, in order to obtain a complete result. For this purpose the method of heating by means of open fires or by steam at the bottom of the shafts is mostly used. Fire-damp does not exist in the Swedish coal mines, wherefore there is no danger in lighting a fire.

For *lighting* purposes kerosine-, gasoline- and rapeoil-lamps are in use.

Sorting and Washing. Usually the metalliferous rock is separated from the sterile by means of picking by hand, the rock having before been crushed, either by machine- or hand-power. The richest ore pieces are first separated, whereupon the remainder, if containing ore, is put to a renewed picking or washing. For some iron ores, magnetic separators are used, and then always the Wenström separator. At some zinc-, lead- and silver-mines concentrating mills are put up for separating the different kinds of ore. The largest of these are the works at the zincmines of Åmmeberg and silvermines of Sala. Through the first mentioned 150 tons of ore or more pass per day. The *coal* is assorted to size by being riddled at the mines. The *clays* are assorted according to their refractory qualities.

Working effect and Production. The amount of loosened rock for underground work per head and per year is usually 900 to 1,000 tons up to 1,200 1,300, calculated on those miners only, who occupy themselves with boring and blasting. By the aid of machines for boring, the last mentioned effect may be increased to 2,500 tons. If the amount be calculated annually per *each* miner, both above ground and in the mine, the output amounts at present to about 390 tons per year.

The average annual *production* of the Swedish mines is shown by the following figures, in metric tons:

	1871—1880.	*1881—1890.*	*1891.*
Iron ore, rock ore	763,769	902,320	985,255
» lake and bog ore	8,018	2,709	2,150
Copper ore	36,716	22,771	21,882
Zinc ore	36,249	49,462	61,591
Silver and lead ore	11,087	14,400	15,044

	1871—1880.	*1881—1890.*	*1891.*
Sulphur pyrites	1,638	1,537	1,659
Manganese ore	607	6,201	9,079
Cobalt ore	180	239	243
Gold ore	?	1,169	2,680
Graphite	48	20	16
Fossil coal *	80,197	179.564	217,836
Refractory clays **	?	65,555	103,221

Surveying. a) *Ore mines.* Triangulation by theodolite is but exceptionally used in Sweden for the surveying of ore mines. This method of surveying is chiefly in use at the very largest and extensive mining fields, and as a rule only for the purpose of marking out a certain number of fixed points in the open and underground. For the surveying between these distantly separated fixed points, as well as for any mine surveying, the so-called Swedish Markscheider-method is always used.

Without entering into details concerning this graphical method, it may here only be said, that the instrument used for this purpose is a tube-diopter, which consists of an alhidade-rule, provided with a tube, which is moveable in that vertical plane, which passes through one edge of the rule. The instrument has, besides this, a vertical circle, graduated to read minutes and also a levelling arrangement. To this instrument belong further some surveying tables, of which always 2 or 3 are in use at the same time.

For measuring the distances between the station-points and the distances from these to the fixed points, measuring-tapes of steel are used. To determine other distances requiring less accuracy, a linen-tape is used, interwoven with wire. Rightly used, this method gives very accurate results, and is well adapted for the surveying of such mines as the Swedish. Besides this less time is required by this method than by triangulation or by those methods involving the use of compass, the latter methods being besides quite impracticable in the Swedish mines, because the Swedish ores almost always have magnetic properties.

b) *Coal mines.* Even for this class of mines the method just described is used, but also, and commonly, the same surveying methods as in other countries.

Maps of the mines. a) *Ore mines.* Like the method of surveying, the Swedish maps of the ore mines are different from those of other countries. They are made so, that the surveying on the ground, as well as every surveyed sole of the mine, are drawn each on their separate paper and all these papers are connected with each other in such a manner, that every sole comes in a true position one above the other. With the aid of these maps, profiles of length and breadth

* From the coal mines of Höganäs, Bjuf and Billesholm. Figures from the other mines are missing up to the year 1888. 1 hectol. coal is assumed to weigh 88 kilog.

** The production from all the coal mines in Skåne for the year 1890 amounted to 978,355 hectol. (= 127,186 tons) of clays (mostly refractory). 1 hectol. refractory clay weighs 130 kilog.

are afterwards constructed and drawn up on separate papers. All the maps of ore mines must be on the scale of 1 : 800, and made in conformity with a standard map, decreed by the Government.

b) *Coal mines.* Maps of coal mines have to be drawn in the scale of 1 : 1,500, and for the design of these maps the Government has also prescribed a standard.

Maps of all the mines, ore as well as coal mines, have to be drawn in duplicates. One of these copies is to be kept at the mine district, the other to be forwarded to the Office of mining maps, at Stockholm, where thus is to be found a collection of all the mining maps of the country. It is further prescribed that in all working mines every new work has to be surveyed, at the latest, on the year following its being begun, and it is the mine-owner's duty to forward these supplementary surveyings to the Office of mining maps, whereby the collection of maps at this office is revised completely from year to year.

Models of mines. The conditions of the ore mines are given not only by maps but also by models. These are of different kinds, but at present only two types are most in use. When a mine with but a small number (6 to 8) of soles is to be represented, these models are painted in oil-colors in the prescribed scale of 1 : 800 on glass-plates. If there be a larger number of soles than that just mentioned, the plates are formed of stiff paste-board and are fixed on wire-gauze, stretched in wooden frames.

Combustibles.

Coal and its mining have recently been treated (pages 98—105). Another combustible that occurs much more abundantly and in many cases replaces coal, may be mentioned simultaneously, though properly speaking not a mineral; and the more so on account of its being used in the manufacture of iron to no small extent.

Peat. The peat-bogs of Sweden occupy a considerable area, about 5 million hectares (12,350,000 acres), and occur in almost every part of the country, but the largest stretches lie in the northern provinces, in Dalecarlia, Vermland, Vestergötland, Småland and the north of Skåne. The nature of the peat-bogs varies greatly, so that not only the different bogs, but even one and the same bog may contain various kinds of peat in different stages of decay, while their depth also differs considerably, from 1 to 12 metres (3 to 40 feet) and sometimes even more.

For a considerable period peat has been used as household fuel in the most southern provinces of the kingdom, more especially along the coast, and where there are no forests for supplying fuel, while during the past 20 or 30 years attention has been more and more directed to using this vast store of fuel for other purposes, and during the last ten years for making peat-litter and peat-mould. Large quantities of peat are now dug in Southern and Central Sweden, at those iron works and other industrial establishments which lie far inland and own peat-bogs.

The crude peat is prepared for fuel in various ways, and formed by different kinds of machines into pressed blocks, bricks or tubes. In some places the peat is worked with water in pugmills, and, out on the field, placed in forms specially made for this purpose. The number of machines of all kinds for the preparation of peat, which were in use in different parts of the kingdom during 1892, may be calculated as about 1,200.

The peat used as household fuel in those parts of the country most destitute of wood is generally the so-called »cut-peat», i. e. peat cut in rectangular form with spades specially made for the purpose, and laid up on the bog to dry, this peat being generally very loose as a consequence of the simple way of preparing it. Peat that is intended for industrial purposes is almost invariably in some way or other worked and tempered so that after being dried it becomes hard and compact, giving off far greater heat when used than cut-peat. The drying of the peat takes place in the open air, either on the bog itself, after the surface has been levelled and drained, or by placing the peat in so-called ricks. Of late years at many iron works drying-kilns of different construction have been erected for again drying the air-dried peat; the heat requisite being derived from waste heat from other parts of the works, so this so-called hot-drying is very inexpensive. Peat is used at iron works in generators either pure, or mixed with coal and sticks; as also at wood-pulp manufactories for drying the pulp, at glass works, brick-kilns, and as fuel for steam engines, etc.

It is impossible to give any exact figures as to the quantity of peat manufactured annually in Sweden, as there are no data; but simply for metallurgical needs from 30- to 35,000 tons are used, and it is more and more employed every year, since, as a general rule, peat is much cheaper than coal. The cost of production for well worked peat varies from $ 1 to 1 1/3 per ton, according to the different wages paid at one place or the other. Good peat contains about 30 to 40 per cent of coal and from 2 to 7 or 8 per cent of ashes.

Peat-litter is now made in large quantities in Southern and Central Sweden, there being about 20 manufactories making it for sale, besides many others simply for their own wants. The Swedish peat-litter in the market is of very best quality, and far superior to that of other countries, since it generally consists of pure sphagnum, or undeveloped peat-moss without any mixture of other kinds of moss. Peat-litter is chiefly used to litter down the cattle in stables and cow-sheds and in the sanitation of towns and communities; being moreover valuable for preserving food, fruit, flowers, etc.

Quarry Products, Building and Ornamental Stones*.

Though the *Stone industry* as a more important source of living is of a comparatively young origin in Sweden, the use of rocks for constructive and decor-

* By Hj. Lundbohm.

ative purposes dates back to an early period. During the mediæval age, when the church architecture was flourishing, the comparatively soft rocks, such as limestones and sandstones were used very extensively. The cathedrals of Upsala, Linköping, Skara, Lund and other cities, as well as the 94 country churches on Gotland, built before 1350, and well known to all, who are interested in the gothic and roman style of architecture, testyfy for the builders of that time a great capacity of judging about the quality of the stone and the method of its use, and also a skill in masonry works, which has not later been surpassed. Even during the following centuries, the stone industry periodically reached a high development, especially in the 17th and the beginning of the 18th century, when the Swedish architecture had its most bright period, and excellent buildings such as the royal castle in Stockholm and many others were erected. This period was followed by a decadence, characterized by a tendency to substitute the natural stone by the cheaper artificial stone and plaster. In a large and thinly populated country like Sweden, this was quite natural as long as the means of transportation had not yet been developed, but, as the country became traversed by numerous railway lines and canals, the stone industry again took a more prominent position, not only to benefit for the Swedish architecture, but also as an important industrial source.

The stone industry is principally based on the following rocks, mentioned in order of their commercial importance: granite, and some other siliceous, crystalline rocks, silurian limestone, cambrian and silurian sandstones, archæan crystalline limestone, clayslates, micashists etc. Besides this, porphyry is used for decorative purposes.

As already mentioned in the introductory remarks on the geology of Sweden (page 6) the archæan rocks, especially granites and gneisses, occupy very extensive areas, and as these rocks are very varying with regard to color and structure, there is an amply supply of the most exellent materials. Probably no other country in Europe has to present so many different kinds of granite, suitable for building and decoration.

The term granite is by stonecutters and architects generally applied to a great number of different rocks, such as gneiss, hyperite, diorite, gabbro, diabase and others. If the word is taken in this commercial sense, the most important districts of granite quarrying are situated in the provinces of Bohuslän and Halland at the west coast of Sweden, and Skåne, Blekinge, Östergötland and Upland at the Baltic sea.

In *Bohuslän* is quarried a true granite occupying a large area along the coast. The color of the rock is generally light-gray, some times light-red, and the structure, varying from very fine-grained to coarse- ore middle-grain, is in the most cases very homogeneous. As types of the granites of this districts may be mentioned one red, coarse, somewhat resembling the famous granite of Peterhead in Scotland, and another gray or pink, fine- and close-grained. There is a

great number of varieties of this later type, some of which are very soft, some rather hard, of the same character as the granite of Westerly, Rh. Isl. In consequence of the very favorable situation of this district and the excellent quality of the granite, it has been quarried extensively and exported to Germany, Denmark and England, the principal products being buildingstone for docks, harbours and bridges, paving stone and monuments. The most important quarries are situated on Malmön, Näset and Lysekil, in the southern part of the district, and at Iddefjorden, near the Norwegian border.

In *Halland* occur two different kinds of gneiss, quarried on many places near the coast. The one of these rocks, found at Varberg, is pyroxenebearing, dark green, very granitic; it takes a high polish and has a reputation as one of the most beautiful monumental stones. Enormous masses are exported to Germany, Scotland and, during the later years, to a small extent even to America. The other gneiss in Halland is a rather hard, fine-grained, as to color very variable rock, which is almost entirely used for street works, the products being exported to Germany and Denmark.

The province of *Blekinge* takes a prominent position among the productive granite districts, owing to its geographical situation, near one of the principal purchasers, Germany, but also to the superiority of its granites and gneisses. These are red and gray, generally fine-grained and very suitable for building stone and street works. Large parts of Berlin and other cities in Germany are paved with stone from one firm, which for many years has employed more than 1,000 workmen.

In *Småland* occur numerous varieties of red granite, the most important of which are found at Vånevik and Virbo, S and N from Oskarshamn. One of this, middle grained, containing blue quartz, is very extensively used for monuments in Germany and during the later years even sent to Scotland and America, where it has been called »Red Swede».

In a small area at Grafversfors in *Östergötland* occur several granites of an extraordinary beauty. One of these is coarse-grained, contains brownish feldspar and blue quartz, another, well known by American monument dealers under the name »Swede Rose», has dark, red feldspar and deep blue quartz. Both are principally used for monumental purposes in and outside of Sweden.

In the vicinity of *Stockholm* are numerous quarries in a gray, fine- or middle-grained granite, very much resembling those of Aberdeen and Dyce in Scotland. The capital has very fine quaies, bridges, piedestals etc. of this stone.

Near Norrtelje in *Upland* are quarried red and gray granites, used for building in Stockholm.

During the later years it has become very modern in Germany to use »black granite» for tombstones and other monuments, and in consequence of this, a great number of quarries have been opened in diorite, hyperite, diabase etc., especially in the southern part of Sweden. The most important quarries are situated near Lake Immeln in Skåne and near Vestervik in Småland.

The abundance of good granite in Sweden causes that quarrying has been undertaken only where the circumstances are very favorable. Thus the more important quarries are all situated in the vicinity of good harbors, and generally sueh places have been selected, where the rock by regular bedding and jointing and by homogeneous structure, is easily quarried and worked. Consequently the production is very cheap, though the methods of quarrying are in many instances not so developed as in America and Scotland. Steam cranes are used only to a small extent and steam drills hardly tried, the reason being that the wages are very low and the handdrillers excidingly clever. Even the dressing and polishing is carried on somewhat slow but generally very accurate. It may be said that often too much work is laid down on the finishing.

Some of the larger works are chiefly based on production of pavingstone. The German cities, being the principal purchasers, have very great pretentions, and, as the competition is very strong, this industry has reached a great development, and excellent stone is produced.

The price of labor in the granite industry is generally a little higher than for other kind of work in Sweden, but compared with the wages in America, the Swedish are very low. A skilled stonecutter can generally earn about $ 220 a year.

The great markets for the granite industry are in Germany, Denmark and England. In the northern part of Germany, most of the large cities exhibit numerous big works of Swedish granite. As examples may be mentioned bridges and docks etc. in Hamburg, Kiel, Wilhemshafen and a great number of houses and monuments in Berlin. The high duty, which in Germany is put on sawed or polished granite works, has been very infortunate to the Swedish stone industry and, in consequence of this, large quantities of raw stock is at present exported to that country. The official statistics gives the following figures about the Swedish export of stone, the principal part of which is granite:

Period.	Annual average.
1881—85	$ 340,000
1886—90	670,000

The enormous masses of *felsite porphyry* and some other hard rocks, occurring in the province of *Dalarne*, attracted attention by its extraordinary beauty already during the last century. After careful investigations a work was then built in *Elfdalen* and supplied with very ingenious machinery for polishing, and the new enterprise was embraced with great interest. Not less than 30 different varieties of rocks have been worked, many of these are fully comparable to the ancient porphyries or still more beautiful, and therefore many of the excellent products, such as urns, vases, table tops, tombstones etc., were exported and made the »porphyry work» at Elfdalen famous all over Europe. One of its most remarkable work is the great sarcophagus of the Swedish king Carl XIV Johan. On account of the hardness of the rocks and other difficulties the economic result became however

gradually less prosperous, until the work some few years ago was rebuilt at *Orsa* in Dalarne and supplied with more modern appliances, which makes its operation more succesful.

The *silurian limestone*, being of an excellent quality for both constructive and decorative purposes, is quarried at a great number of places and no other rock is at present used as building material to such a great extent.

Among the numerous *archæan, crystalline limestones* in Sweden, there is only one which has been used to any extent, viz. the beautiful green ophicalcite, occurring in large quantities in the mountain range Kolmården. The rock is very suitable for interior works and has been used in the royal castle of Stockholm, the great opera house of Paris and many other monumental buildings.

The precambrian and silurian sandstones are quarried on a few places for building purposes, and the same rocks are also used for grindstone. Whetstones and scythe-stones are manufactured in a small scale of micashist and clayslate.

The Geological Survey of Sweden has published several monographs and pamphlets on the stone industry of the country in general and of certain districts, and the same institution furnishes with information about the Swedish rocks and stone quarries. Compare page 164.

Clays and their products. Cement*.

Clays. In the north-western part of Skåne, several rocks occur, belonging to the Jurassic system, and extending for about 500 square kilom. The productive layers found there consist of coal, clay-slate, and more or less carboniferous argils. Coal occurs in several different strata with a total thickness of from 0·5 to 0·8 m., of which, however, it is very seldom that more than half gives satisfactory fuel. The dark clays are sometimes several metres in thickness and provide the raw material for the production of ordinary fire-proof goods; the clay-slates that occur in the Billesholm, Ljungsgård, and Bjuf pits are renowned for their peculiar power of resisting fire, and of all plastic raw material form the best fire-clays that have ever been worked on a large scale. In one field at Stabbarp there is a light clay which at the same time is both plastic and fire-proof. The ordinary dark fire-clay is found in every field except at Stabbarp. From one field, Skromberga, a clay is obtained which is very remarkable — after being burnt — for its giving a product of extraordinary strength and so hard that no other clay previously manufactured has ever attained the same degree of solidity.

The coal and clays occur in alternate layers and are dug simultaneously, and a very considerable amount of the former is used in producing the latter. The quantity of coal yearly dug is about 200,000 metric tons or 10 per cent of the total consumption of fossil fuel in Sweden.

* By Professor A. W. Cronquist.

The following is an epitome of some ehemical analyses of the most important of the elays on whieh is based the Swedish fire-elay industry — tests free from water and organie matter:

Pits.	Brand.	Silica.	Alumina.	Oxide of Iron.	Lime & Magnesia	Alcalies.	Class of fire-proof.
1. Höganäs	Höganäs	64·2	30·1	2·0	1·2	2·5	3—4
2. Stabbarp	Höganäs / Stabbarp	60·8	36·1	1·7	0·7	0·7	6
3. Bjuf	Bjuf F	54·2	42·0	1·6	1·0	1·2	6
4. Bjuf	Bjuf K	65·6	28·1	2·3	2·4	1·6	4
5. Billesholm	Billesholm	50·3	44·1	2·3	2·1	1·2	6
6. Billesholm	Svaneholm	67·8	25·9	2·4	0·8	3·1	3—4
7. Skromberga	Skromberga	73·0	20·2	2·3	1·7	2·8	2

There is eertainly no other land that possesses a raw material so rieh in alumina, or so suitable for fire-proof goods as Nos 2, 3, and 5, more espeeially the two last mentioned. The Billesholm's lamina (No 5), for this reason, also provides the raw material for the preparation of salts of alumina, and the day is surely not far distant, when the same raw material will serve as aluminium ore.

The manufaeture of fire-elay bricks and goods is at present undertaken in Sweden by 4 different companies, employing about 1,000 hands, the output being valued at about $ 670,000.

The most ancient of these establishments, situated at Höganäs, in the vieinity of a good harbour, eommeneed operations in 1827, and, more espeeially of late years, has made rapid strides. At these works, and those of Stabbarp eonneeted therewith, the number of fire-proof bricks manufaetured — reduced to the dimensions of $9'' \times 4^1/_2'' \times 2^1/_4''$ — at present amounts to 12 to 13 million bricks a year, whieh is about two-thirds of the entire number produeed by this country. Of the bricks manufaetured during the past 7 years — about 57 million — 36 million have been exported to foreign eountries.

Besides the manufaeture of fire-proof goods, the making of glazed drain-pipes plays an important rôle at Höganäs, since no less than about 350,000 of them are annually manufaetured, corresponding to a length of about 200 English miles, and about two-thirds of these drain-pipes are exported, mostly to Denmark.

The salt-glazed pipes supplied by the Swedish firms are renowned for a very high degree of eompaetness and the eomplete impermeability of the salt-glaze; so these pipes are preferable to, in other respects, very exeellent eement pipes that are east.

The Höganäs Works are also known for their manufaeture of yellow and leather-eoloured ornamental and Verlilende wares, Majolica, ete, of which samples may be seen in that part of the Exposition devoted to Sweden.

The works of the Skromberga Co. are of very recent date. The raw material here consists of a very ordinary clay as regards being fire-proof, but which is extremely plastic and concretes very evenly and may for this reason be worked into very pretty and valuable articles. The tiles and salt-glazed pipes of Skromberga are of very excellent quality, as has been already mentioned, and provide a material surpassing quartz in hardness and rivalling emery (Moser's scale No 9). The excellence of the goods manufactured has obtained for them a wide and important market, more especially abroad, where they were used as well for the North Sea and Baltic Canal, as for several light-houses and other buildings exposed to being greatly waterworn, and have been found to fulfil satisfactorily the great demands made.

The quality of the Höganäs and Skromberga pipes will be seen from the following table:

Manufacturers.	Inside diameter in		Thickness of goods, centim.	Length, centim.	Tensile strength, kilog. per sq. centim.	Water absorbed, weight per cent.
	English inches.	centim.				
Höganäs Co. Lim.	4	10·2	5·5	60	22·0	11·1
» »	6	15·3	6·6	60	27·0	11·6
» »	9	22·9	7·4	62	58·3	10·0
» »	12	30·5	8·5	75	45·3	10·5
Skromberga »	4	10·2	4·8	60	65·0	3·0
» »	6	15·3	6·6	61	71·3	4·2
» »	9	22·9	7·5	77	44·3	3·1
» »	12	30·5	8·3	77	50·7	3·5
» »	15	38·1	10·2	76	51·0	3·6
» »	18	45·8	11·6	77	48·7	3·1

Next to Höganäs — as regards the amount of production — comes the Kropp Company, as their yearly output of fire-proof goods amounts to close upon 7 million bricks, reckoned as $9'' \times 4^1/_2'' \times 2^1/_4''$, there being two kinds of clay worked, the one quality branded Bjuf F being extremely fire-proof and belonging to the highest class (6), whereas Bjuf K is simply of ordinary stability (4).

Vallåkra Company produces about half the amount that the Kropp Co. does, has similar raw material, and two brands of which »Billesholm» is the better.

Besides those fire-clays previously described, Sweden possesses an inexhaustible supply of plastic glacial clays, mostly marine deposits, which form exeellent raw material for bricks for building purposes, and are used very extensively, more particularly in the vicinity of the large towns, and in the southern parts of the country, where the supply of wood is not so abundant as elsewhere. The largest *brick-kilns* are to be found in Skåne, and among them Börringe, Minnesberg, Lomma and Rögla are deserving of special mention, being all in the province of Malmöhus and producing very superior bricks, both for façades and ordinary building purposes.

The quality of some of the more important Swedish bricks will be seen from the following table founded on the tests made by a »Test Office» at Gothenburg.

Tensile strength. Kilog. per sq. centimetre.	No of series tested in each group.	Specific gravity.	Volume weight.	Absorption of water, % of weight.	Porosity, % of volume.	No of dry-crushed stones in every series.	Tensile strength of bricks kilog. pr sq. centim.		
							Dry.	Placed in water.	Frozen 25 times.
1,000 and more*	2	2·51	2·18	2·1	10·8	5·5	**1,147**	826	1,153
400—999.....	6	2·60	2·08	5·8	18·8	8.0	**526**	684	656
300—399.....	11	2·64	1·84	14·1	30·0	6·2	**347**	356	307
200—299.....	17	2·66	1·76	15·5	32·4	6·5	**240**	247	238
100—199.....	14	2·62	1·73	15 8	31·6	5·9	**164**	202	173
1—99	5	2·65	1·56	21·1	39·0	7 0	**68**	98	94
Average	—	2·61	1·80	14·2	30·1	6·4	**295**	313	298
Average (without including Skromberga clinkers) .	—	2·64	1·79	14·7	30·8	6·5	**258**	293	265

* Skromberga paving and façade clinkers.

Cement. At several of the more important building enterprises which were formerly carried out in Sweden — for instance the large canal that traverses the country and connects the Baltic with the Cattegat — an hydraulic mortar was used made of lime and burnt and finely crushed bituminous slate (alum slate), belonging to the Silurian system and occurring in great quantities in certain parts of the country. This cement is very inexpensive and of first-rate quality, but sets slowly and for most purposes cannot bear comparison with Portland Cement; its use has therefore, of late years, greatly decreased, more especially since we ourselves began to make Portland Cement. Excellent raw material for this purpose is found in the very general Archæan, Silurian, and calcareous minerals belonging to the cretaceous system, and that marine clay which is widely spread in by far the greater part of Southern Sweden. Twenty years ago attempts were made to take advantage of this rich supply, since which time the manufacture of cement has developed and is now a very important industry, which not only almost entirely supplies the demands of our own country, but also gives occasion for a considerable export of this article. The cause of this rapid progress is not only the excellent quality of the raw material, but perhaps to a still higher degree is owing to the manufacture being under the immediate supervision of chemists, who are skilled in technics, and carefully watch over the whole procedure. One peculiarity appertaining to the Swedish cement, that calls for special notice, is its extreme fineness, which allows of a greater addition of sand than other kinds of cement, and consequently has contributed to a very high degree in making it satisfactory.

At present Sweden has four works for making Portland cement, each very

favourably situated. The oldest belongs to the Scanian Cement Co. Lim. and lies near Malmö. As raw material they here use — besides marine, glacial clay — a cretaceous limestone which is loose, easily pulverized, and is very constant in consistency. The manufacture is carried on with the very greatest care and the company — to whom honour is due for having founded and developed the cement industry of Sweden — have found an extensive sale both in Europe and America for their product which is known by the name of Lomma Cement or Kangaroo Portland Cement. In connection with this business, since 1887, a company — entitled the Scanian Cement Foundry with their chief office in Malmö — undertakes all kinds of work where cement can be called into use, as the laying down of sewerage and water conduits; underground pipes for electric cables; bridge-building; laying foundations; house-building works in cement beton; cement mosaic; etc. The principal staircase, floor, and wall-covering of the Swedish building at the Chicago Exposition are all laid by this firm.

On Gotland, Portland cement is manufactured at works that were established in 1882 belonging to the Visby Cement Manufacturing Co. Lim., that use for raw material Silurian limestone and marl-slate which seem inexhaustible on this island. The Öland Cement Manufacturing Co. Lim., at their works at Degerhamn, since 1886 have manufactured Portland cement on a large scale from Silurian limestone and glacial clay; this cement being known by the brand »Isbjörn». As fuel a strongly bituminous slate is partly used, which slate is obtained on the spot, and moreover, forms the raw material for the manufacture of alum. Recently cement works were opened at Kinnekulle in Vestergötland, where unlimited supplies of Silurian limestone and glacial clay form the raw material used.

As an instance of the quality of the Swedish Portland cement the following analyses and results of tests are given:

Analyses of Portland Cement from the *Scanian Cement Co. Lim.* made in December 1891 by Henry Feija, Member of the Institute of Civil Engineers, London.

Moisture	1·05	Oxide of Iron	3·43
Carbonic Oxide	0·75	Lime	64·00
Silica, Insoluble	5·25	Magnesia	1·41
» Soluble	16·00	21·25	Sulphuric Oxide	1·61
Alumina	6·47		99·97

The same specialist gives as a result of tests made:

Residue when sifted through a No. 100 sieve ..... 1·5 pr cent
» » » » » 70 » ..... trace.

Weight per bushel = 99 lbs 2 oz. Specific Gravity = 3·062. A part examined for soundness gives no indications of either expansion or contraction.

Tensile strength pr square inch: Neat cement, 3 days test average 345 lbs; 14 days 788 lbs; 7 days 662 lbs, and 28 days 781 lbs. — Sand test (3 of standard

sand to 1 cement by weight gauged with 6·56 per cent of water), 7 days test average 288 lbs; 14 days 340 lbs; 28 days 374 lbs.

The Royal Institution for testing building materials in Berlin gives the following crushing weight for cement from the Scanian Cement Co. Lim.: Average of 5 tests; the briquettes placed 24 hours in the air and afterwards in water; lbs per sq. inch:

	7 days.	28 days.	60 days.	90 days.
Neat cement	4,995	5,689	6,628	7,325
1 cement, 3 sand	2,347	3,129	3,641	3,883

Portland Cement from the *Visby Cement Co. Lim.*, tested Nov. 1891 by W. W. Maclay, M. A. Civil Engineer, New York U. S., showed the following results:

Tensile strength per square inch, briquettes kept in moist air until 24 hours after gauging, afterwards immersed in water until weakening: Pure cement, 7 days test, average 434 lbs; 28 days 674 lbs; 1 cement 2 sand, 7 days 150 lbs; 28 days 234 lbs. The cement is very finely ground and slow setting, taking about $2^1/_2$ hours to set hard.

The state of the cement industry and its development in Sweden is shown by the following figures:

Year.	Manufacture. Casks.	Import. Casks.	Export. Casks.
1874	16,000	31,400	—
1881	82,591	26,789	44,550
1890	196,591	4,975	79,564

In 1891, at the oldest cement works, Lomma, 209,969 casks were manufactured, and the entire production may be calculated as about 335,000 casks.

Mineral Waters.

The Swedish mineral waters, as a consequence of the geological formation of our peninsula, are not of such different kinds as those of the Continent. With very few exceptions they belong to the group of mineral springs called »ferruginous waters». In almost every one of our provinces these springs — more or less weak in iron — are to be found being called by the peasantry »sour wells». Their chief component part is proto-carbonate of iron in varying quantity from 0·103 per 100 grammes (Karlstad) to 0·001 per 100 gr. (Söderköping). The more important of this group and consequently those called mostly into requisition are Porla, Lundsbrunn, Lannaskede, Ramlösa, Medevi, Sätra and many others. The strongest of these springs, Karlstad, is not so much taken on the spot itself as transmitted to various other parts.

In another group of ferruginous waters we must class Ronneby, one of the very strongest iron springs in the world, containing sulphate of iron and alum in

considerable quantities. Ronneby is that spa in Sweden which attraets most visitors and about 2,000 persons annually take the waters there. Besides these ferruginous springs there are in Sweden but 2 salt springs (chloride of sodium) which belong to that class of waters called bromo-jodulated waters; these being Torpa, which is simply transmitted, not taken on the spot, and the Sophia spring at Helsingborg. A single well belonging to the group called alkaline effervescing waters has lately been discovered in Vestergötland, the Skofteby spring, the water greatly resembling Selters and being only used for transmission. At all our ferruginous spas there are very good bathing-establishments (see page 199.)

Besides these natural mineral springs, *artificial* water is used to a considerable degree, being of excellent make. At all the larger manufactories of mineral waters the production is under scientific control.

Metallurgy of Iron and Steel*.

Iron and Steel. The ores principally used for producing iron are *magnetic oxide of iron* (Magnetite) and *specular iron-ore*. Both occur in older crystalline rocks and have a compact texture, on account of which they are somewhat difficult to reduce, more especially the magnetite. On an average these ores contain about 53 per cent of iron and carry as *rock* quartz, hornblende, epidote, garnet or carbonate of lime. The specular ore is commonly accompanied by quartz or siliceous rock, and for smelting requires an addition of lime, while on the contrary the magnetite commonly contains hornblende or other easily melted silicates, sometimes also carbonate of lime, in consequence of which this ore can often be melted by itself or requires simply an addition of silica. Sometimes a mixture of both kinds of ore is used. Besides the above ores in some regions »lake and bog ores», brown hæmatites, occur in considerable quantities with a proportion of iron amounting only to 25 à 30 per cent. Formerly these ores were much used for the production of cast-iron, but nowadays they are very little employed, and the whole quantity of lake and bog ores, dug up in 1891, amounted only to 0·2 per cent of the total ore-production.

Several magnetic iron-ores, as for instance those from the mining-districts of Dannemora and Norberg, contain from 1 to 5 per cent of manganese and are especially suitable for the production of pig-iron for the Bessemer- and Open-hearth-processes, others on the contrary, as for instance the magnetic iron-ores from Schisshyttan and Hilläng, contain the mineral knebelit in such a degree that their proportion of manganese amounts to 12 à 20 per cent, on which account they are used for producing specular cast-iron (Spiegeleisen), or as an addition in the melting of ores poor in manganese. The iron-ores of central Sweden contain generally very little phosphorus, and especially the magnetites in the larger deposits of ore, as

* By Professor J. Wiborgh.

Dannemora, Persberg, Ställberg, etc. are distinguished by their low proportion of phosphorus, amounting only to 0·001 à 0·005 per cent; on the other hand the specular ore is only exceptionally so free from phosphorus, and often contains as much as 0·03 à 0·1 per cent. In some special deposits of ore, as for instance at Grängesberg, the proportion of phosphorus is higher, say from 0·08 to 2 per cent. The large deposits in the northern division of the country, Norrbotten, are at present not used for any production of iron in this country. Their proportion of phosphorus varies very much, from 0·02 up to between 6 and 8 per cent. The sulphur in these ores is generally very small in quantity.

By the above remarks it is seen that the country has a very good supply of ores, both of the purest and most suitable for producing the most excellent steel, as also of the more common ones for manufacturing purposes.

For the Swedish iron industry *charcoal* is the most important fuel. Charcoal is principally made of pine and fir, and, to a smaller degree, of birch. The charcoal-making is executed out in the woods in kilns; only exceptionally the wood is charred in furnaces. Generally the charcoal is used just as it comes from the kilns; but at some places as Dalkarlshyttan, Bångbro, Hofors, Sten's ironworks, etc. the charcoal is dried before being charged at the high-furnace. The drying is executed in such a way that hot air, by means of a ventilator, is passed through those baskets in which the charcoal is loaded for the transport to the top of the furnace. The air is heated by means of the lost heat from the open mouth, or from the hot blast stove. The production of pig-iron and the fining thereof by hearth processes are exclusively executed with charcoal, except a small quantity of specular pig (at Schisshyttan), in producing which a mixture of coke and charcoal is used. For the open hearth- and puddling-processes, and for the welding of the iron, coal, peat, wood, or saw-dust are employed according as the one or other fuel is cheaper at different places.

Fossil coal (see page 98), mined in Southern Sweden, is not used for metallurgical purposes; *peat* (see page 105) only for gas-generating in the open hearth- and welding furnaces.

During the year 1891 there were at work 155 blast-furnaces in which were produced 500,000 tons pig-iron, with an average production of 12·2 tons per day and furnace. Depending upon the quality of the ores and the fuel, the consumption of charcoal varies from 50 to 75 hl. per ton of pig-iron and can on an average be reckoned at 60 hl. The largest production is at Domnarfvet's ironworks, where the production of pig-iron per day and furnace rises to 40 tons The height of the blast-furnaces varies from 13 to 17 metres, the diameter at the tuyeres 1·3 to 1·8, at the base 2·4 to 3 and at the mouth 1·5 to 2 metres. Their capacity is 40 to 90 cubic metres. The number of tuyeres is 2 to 6 and their diameter 50 to 120 millimetres all depending upon the capacity and production of the furnaces. Generally the driving in 24 hours does not exceed 1·25 to 1·5 capacities of the furnace; only exceptionally it rises to 2·5 à 3 capacities (Domnarfvet). For

the most part, the mouth of the furnace is open and the gas is led away behind a suspended cylinder of plate iron; but of late years covers over the mouth have been used, as at Björneborg, Domnarfvet, Avesta, and other places. For the heating of the blast pipe-stoves are used according to different systems, partly with horizontal, partly with standing pipes; but the heating surface is generally small, and varies from 0·5 to 1·5 sq. metres per cubic metre of air (of 0° and 760 millim. pressure) passing per minute through the stove. The use of so small hot blast stoves depends principally on the fact that in the greater number of the furnaces pig for hearth-fining is produced, in which case greater heat than 200 to 250° C. is inconvenient. In producing certain kinds of pig (at Dannemora) and at some furnaces, where pig for malleable cast-iron is produced, cold blast is used. Regenerative heating stoves are to be found only at two works, Björneborg and Domnarfvet; they are of Cowper's system and give a temperature to the blast of 600 to 800° Celsius.

Calcining of the ore. Generally all ore is calcined, partly for evaporating sulphur, partly for making the ore more porous and easier to reduce, and only exceptionally specular ore is used uncalcined (Domnarfvet, Avesta). The calcining of the ore is performed better and more completely in Sweden than in any other country. A good calcination here is also more important than in most other countries, while, charcoal being used as fuel, the melting temperature is relatively low, and the ores generally being siliceous, it is both cheaper and more appropriate to eliminate the sulphur by calcining than by basic slag. The calcining is executed by means of high-furnace gas in Westman's calcining furnaces, which are built commonly after the original model, but sometimes, at some smaller furnaces, slightly changed in order to make them cheaper.

The composition of the slag is adapted for Lancashire pig-iron, to be about bi-silicate; for cast-iron, tri-silicate; and for Bessemer pig-iron, tri- or sesqui-silicate. Generally the slags are poor in alumina and rich in magnesia and in consequence somewhat hard melted.

Cast-iron and pig-iron for the Walloon fining-process are cast in sand-forms, other kinds of pig in iron moulds. Of the pig-iron produced about 45 per cent is used for fining in hearth, 35 per cent for the Bessemer and open-hearth methods; of the remaining 20 per cent most is exported and only a small part used in the country for casting purposes.

As above mentioned the content of phosphorus in the ores is often very inconsiderable, but as the charcoal always contains some phosphorus, the pig seldom contains less than 0·015 per cent, but rises generally to 0·02 à 0·03 per cent, when produced from the ores most free from phosphorus. The fuel being completely free from sulphur and the ores carefully calcined, the proportion of sulphur in the Swedish pig-iron is very insignificant, seldom amounting to more than 0·02 per cent, but often falling below 0·01 per cent.

At several Swedish blast-furnaces some castings are produced directly from

the furnace simultaneously with the common pig-iron and without remelting it. The castings produced in this way are parts of fining hearths, pipes for hot air stoves, plates, and similar goods, amounting to about 1 per cent of the whole production of pig. Moreover castings of various kinds are produced by remelting of pig in cupolas. In 1891, 133 establishments were provided with cupolas, in which were produced 37,500 tons castings. As material for producing castings a mixture of English and Swedish pig, in varying proportions, is used according as the product should be soft or hard, or have a lower or higher degree of tenacity. For very soft castings English pig is used almost exclusively, but for hard and strong castings chiefly Swedish. The height of the cupolas is 3 to 4 metres with a diameter at the tuyeres of 0·6 to 1 metre. The number of the tuyeres is 2 to 6 and the production 2 to 4 tons melted pig per hour with a consumption of 100 to 140 kg. coke per ton of pig, the heating coke included, otherwise 60 to 80 kg. Concerning the construction of the furnaces, some of them are supplied with forepart (Krigar's construction), others have none, and the tuyeres are commonly placed in two rows, exceptionally in spiral form.

Most part of the wrought iron produced in this country is fined in hearths with charcoal as fuel. The Lancashire fining-process is the most used; more seldom the Franche-Comté and the Walloon methods are employed. In 1891 193,500 tons wrought iron were produced, of which 181,000 tons in the Lancashire, 5,000 tons in the Franche-Comté and 7,500 tons in the Walloon method.

The *Lancashire fining* is executed in small hearths composed of pig-iron sheets. The hearth has a length of 850 mm. a width of 250 mm. and has 1 to 3 tuyeres, which are somewhat pushed in and inclined 8 to 12° against the bottom. To every charge is used 100 to 180 kg. pig, which ought to be half-white, have an insignificant percentage of manganese, and contain 0·2 to 0·5 per cent of silica. The blast is heated to about 100° C. by the gases escaping from the hearth; the pressure of the blast is 60 to 100 mm. of mercury. Per hour there are produced about 100 kg. blooms with a consumption of 114 to 120 kg. of pig and 4 to 7 hl. of charcoal. The fining continues day and night during 6 days a week, and in this time 14 to 16 tons of blooms are produced in every hearth. Each hearth requires 4 to 6 hands who work alternately. The melted balls are squeezed under heavy hammers weighing 1 to 4 tons, commonly worked with water-power, and sometimes directly rolled, but for the most part previously welded in special welding-furnaces and then rolled to bar-iron, nail-rods, wire-rolls, etc. The welding-furnaces used are partly so-called Ekman's gas-furnaces in which the gas is produced in a generator in connection with the furnace and then burnt with blast in the furnace itself, partly regenerative gas-furnaces. The fuel used in the first mentioned furnaces is a mixture of coal and wood, or charcoal, peat, and wood; in the last mentioned of peat, small-wood, sawdust, etc. According to the size of the furnace and the dimensions of the iron, from 40 to 80 tons a week are drawn out, with a waste of 8 to 14 per cent.

The Franche-Comté fining process. At this fining process the same kind of hearths is used as in the above mentioned Lancashire process. Still the hearth has only one tuyere and the blooms are welded in the hearth itself and not in separate welding-furnaces. This fining method is only used at some smaller works, where the production is so small that it would not be economical to have separate furnaces and hands for the welding and drawing out of the iron.

The Walloon fining method. This process is only used at the Dannemora works for producing, by means of pig prepared from the finest ores, wrought iron quite free from phosphorus and exclusively used for the production of blister-steel and first-class crucible cast-steel. The pig-iron for this process should be white and cast in sand-forms to 6 m. long pigs. The hearth resembles a Lancashire hearth, but has at the back an aperture, through which the pig is thrust for melting. The blooms are not welded in a welding-furnace, but in a special hearth. For producing 100 kg. of bar-iron 125 kg. of pig and 18 hl. of charcoal are needed. Both the consumption of fuel and the waste are consequently very high and the iron is expensive in production; but it is of excellent quality and the phosphorus contained rises scarcely to 0·006 per cent.

The puddling process is very little used in Sweden. In 1891 only five puddling furnaces were at work and their production was 2,600 tons iron and steel. The furnaces are partly single, partly double, and the fuel is coal or wood. The puddle-steel produced (at Surahammar) is employed as axles for locomotives and railway carriages.

Bessemer. In Sweden there are 15 Bessemer-works which in 1891 produced 93,000 tons Bessemer-metal. Of these works one is supplied with 4 converters (Domnarfvet), the others have generally 2 and, exceptionally, only 1 converter. The converters are of common form; at the Avesta works they are very small, of Robert's construction, and have only one tuyere placed at one side of the furnace. Generally the converters used are not larger than for charges of 3 to 4 tons, but at Domnarfvet the charge is 6 tons. The converters are lined with silica-bricks or mortar of quartz. The bottom has 9 to 16 tuyere-stones, each with 7 to 12 tuyere-holes. The area of the tuyeres is 12 to 30 cm. per ton of cast-iron and the pressure of the blast 800 to 1,200 mm. of mercury. For the basic process the converter is lined, as usual, with dolomite mortar. The Bessemer pig contains commonly 2 to 2·5 per cent of manganese, 1 per cent of silica and 0·025 per cent of phosphorus. After casting in a small mould it is white at the brim to half-white; it is always taken directly from the high-furnace into the converter. Only at a few works the pig has a higher content of silica and less of manganese. The basic process is used only at Domnarfvet, and the pig for this purpose contains 2·5 per cent of phosphorus and very little silica. In working steel the process is checked when appropriate proportion of carbon is reached, and commonly no recarburating is used. Sometimes some manganiferous iron is added at the end of the process, sometimes not. The blast engines for the Bessemer process are driven

with water-power and are calculated at 400 to 700 horse-power. For getting the ingots »tight» at several works the Casperson converter shank is in use and at one of the works, Nykroppa, »centrifuging» during the solidification of the steel in the moulds (patented by Sebenius). The waste amounts to 12 à 15 per cent. Some of the ingots are exported, but the greater part is manufactured in the country into plates, rails, nail-rods, wire, etc.

The Siemens-Martin or *Open-hearth process.* This method has of late years come more and more into use, and in 1891, 78,200 tons were produced of such metal at 22 works. The furnaces are lined with Dinas bricks (Silica bricks) for the acid process and with rammed dolomite mortar for the basic. As an isolating material between the dolomite lining and the acid brickwork, in vaults and bridges, magnesite bricks or chrom-ore are used. The basic open-hearth process is only used at a few works. As fuel coal, peat, wood, or sawdust is used. The furnaces are constructed for charges of 4 to 15 tons composed of pig-iron, wrought iron and ore in varying proportions, and at the end of the process some ferro-manganese or silica-iron and alumina is added. At the greater part of open-hearth works steel castings are made, as at Bofors, Söderfors, Surahammar, Kohlsva, Finspong, etc. For moulding-sand quartz-sand, or ground sandstone with some refractory clay, is used and sometimes for finer castings a little addition of graphite. The moulds are dried and heated in separate chambers fired with wood or high-furnace gas. Where large pieces are cast, there are often fireplaces under the floor of the works. As produced of especially pure materials the Swedish Martin-metal is of excellent quality. Besides being employed for casting purposes it is used for plate, wire, horse-shoe nails, etc.

Blister-steel is produced at but few works, as at Munkfors (Uddeholm) and Österby (Dannemora). As material for this process only the best and purest wrought iron is used (at Österby, Walloon iron). Part of this steel is drawn out under hammer and exported, the other part is manufactured at the place itself into cast-steel.

Crucible cast-steel. This process is used only at two works, Österby and Vikmanshyttan. The whole production in 1891 amounted but to 700 tons. For the cast-steel production at Österby only blister-steel prepared of Walloon iron is used, and the steel produced here is of the very finest quality. The crucibles are made of a mixture of fire-proof clay, caolin, and some cokes-powder. They contain about 19 kg. and the smelting is executed in regenerative furnaces with coal as fuel. There are two such furnaces at the works, each holding 10 crucibles. About 4 castings a day are made in each furnace. At the other works for cast-steel, Vikmanshyttan, the Uchatius cast-steel process is used. The materials consist of granulated pig-iron, rich, pulverized iron-ore and some charcoal, the smelting of which takes place in graphite crucibles heated with coke in common English draught furnaces. The steel is used for augers, hammers, sledges, etc.

Ferro-manganese and *specular cast-iron* are produced only in one high-furnace,

namely Schisshyttan. The ore is a magnetite containing knebelit and the fuel a mixture of coke and charcoal. Still the proportion of manganese in the pig does not rise any higher than to 18 à 20 per cent; but it is particularly pure and commonly does not contain more than 0·04 per cent of phosphorus and 0·01 per cent of sulphur.

The determination of *carbon* in iron and steel is executed partly after the coloration-assay invented by Professor Eggertz, which, with some minute modifications, has been introduced in nearly all ironworks of the world, yet by which only the chemically bound carbon can be determined, and partly by oxidizing with sulphuric acid and chromic acid after a method invented by Prof. Särnström. The sample, which ought to be in a finely divided state, as filings or powder, is first treated with concentrated sulphate of copper in which most of the iron is dissolved, and then in the same cucurbit with boiling chromic acid and sulphuric acid, by which the freed carbon is oxidized to carbonic acid which is taken up in a potassa-tube. In case some carbon should evaporate in form of hydrocarbons the gas is led through a porcelain globe-tube filled with glowing oxide of copper. Both for regenerating this, as also for soaking out all the carbonic acid from the apparatus, a constant stream of air is led through the same and also through the potassa-tube. This air must of course first be purified by being led over hydrate of potassium, as also, after having passed the tube with copper-oxide, be freed from all moisture, before the carbonic acid is absorbed in the potassa-apparatus. The advantage of this method is that no carbon need be filterd, nor can any carbon be lost as hydrocarbon. A complete description of this method is to be found in Prof. V. Eggertz' book »On Chemical Assays of Iron, Iron-ores, Fuel and Fuel-gases», 2nd edition, issued since the death of Prof. Eggertz by C. G. Särnström.

The remainder of the book describes all the methods invented and in use in this country, as for instance the coloration assay of Prof. J. Wiborgh for the determination of *sulphur* by leading the hydrosulphuric acid, originated by dissolving iron in diluted sulphuric acid, through a piece of linen soaked with acetate of cadmium, and then compare the resultant colour with a standard scale of coloured linen received in the same way from a normal iron with known percentage of sulphur, and indicating different proportions of sulphur from 0·005 per cent up to 0·1 per cent. By taking samples only half so heavy, the proportion of sulphur can of course be determined by the same standard scale up to 0·2 per cent, etc.

The determination of *phosphorus* is executed by a method nearly corresponding to the assay of Prof. Eggertz, but with this difference, that the drying is executed at 200° C. in order to get the phosphoric acid in a state to be completely precipitated by molybdenic liquor, as described in the above mentioned book, 2nd ed.

Manganese is commonly determined by titration with cameleon solution after Särnström's method, described in the same book. This method was invented con-

temporaneously with that of Volhard, but differs from it principally in the fact that the solution is made feebly alkaline with bicarbonate of soda, and that the precipitated oxy-hydrate of iron is not removed before the titration, by means of which the method is simplified and loss of manganese prevented. The same determination can be used in the analyses of ores, by which a simplification of no slight significance is gained.

The exchange of iron and steel with foreign countries, during the period 1886—90, was as follows, in metric tons:

Year	Pig iron and castings.		Wrought iron and steel *.	
	Import.	Export.	Import.	Export.
1886	22,946	38,371	59,723	194,369
1887	18,459	49,456	55,841	236,918
1888	31,626	49,278	46,977	219,032
1889	25,125	79,608	42,683	248,995
1890	32,020	60,330	32,263	211,834

The Association of Swedish Iron Masters (»Jernkontoret») is composed of the iron-masters of Sweden, nearly all of whom are members.

The object of the Association is the promotion of the Swedish Iron Industry, which it effects by advancing money to its members, to assist them in extending their works; and by making appropriations for experiments, and the investigation of new processes and improvements. The Association also defrays the cost of publication of an Annual (»Jernkontorets Annaler»), which gives an account of the progress and improvements in the iron industry. This highly valued journal has been issued uninterruptedly since 1817, and is therefore in its 77th year of publication. The Association meets every third year, i Stockholm, to discuss business matters of common interest, as well as technical questions. During the interval between the regular meetings of the Association, the management of its business is entrusted to five ordinary and five extra administrators, who are elected at the regular meetings.

The Association was founded in 1745; its capital accrued from the annual contributions of the iron works is S 1,366,266, its income for 1891 was S 68,304, and expenses S 67,148.

Metallurgy of Copper, Zinc, Nickel, Cobalt, Gold, Silver and Lead **.

Copper. Next to iron, copper is the most important of the metals worked in this country. After having previously been undertaken in many different localities,

* Bar iron, rails, plates, billets, ingots, nails, etc.
** By Professor C. G. SÄRNSTRÖM.

and at nearly every mine, the production of copper is nowadays limited to the copper-works of Falun, Åtvidaberg, and Kafveltorp, and in later years the superphosphate-works of Helsingborg, where the production of copper is carried on as an important by-trade, the copper (and silver) being extracted from the brands fallen in the manufacture of sulphuric acid from mundic containing some copper-pyrites. At the former of these works ores are worked from the very old mines of »Stora Kopparberget», the first mention of which dates more than 600 years back. The copper-works of Åtvidaberg, which are perhaps just as old, obtain their ores from the adjacent mines of Bersbo and Steffenburg; the Kafveltorp works from the mines of the same name. The works at Helsingborg have hitherto taken their mundic from Rörås in Norway, but have just begun to fetch ores from the immense layers of pyrites lately discovered in the neighbourhood of Sulitelma. Besides at these works, the smelting of copper was formerly undertaken at several places in the country, as at Riddarhyttan, Håkansboda, Virum, Husâ, Kengis, etc. where now no manufacture of copper takes place, partly for want of ore, partly on account of the decrease in price of copper. In all these localities, the copper occurs almost exclusively in combination with sulphur, as a copper-pyrite, mostly incrustated in siliceous rocks, or as an intimate mixture with iron-pyrite. The ores now worked on an average contain at most 3 per cent of copper.

As far as up to the beginning of 1870, shaft-furnaces were used for the smelting of the ores according to a method which in metallurgical science is called »the Swedish copper-process» in distinction from the English process which is exclusively carried on in reverberatory furnaces.

On account of the small percentage of copper in the ores and the rising price of the fuel, this smelting process is now given up, and the wet or extracting process was introduced at Falun in the beginning of 1870 and afterwards adopted at most of the copper-works in activity. According to this method the ore, together with chloride of sodium, is calcined at low temperature, and the soluble salts are extracted with water and some acid in large wooden basins. From the solution, silver is first precipitated, and then the copper is cemented by means of refuse iron. The cemented copper thus obtained, which contains 70 to 80 per cent of copper, is pooled and refined in regenerative reverberatory furnaces.

In 1891 the whole production of the country was about 540 tons of blister and refined copper, and 120 tons of cemented copper. In contrast it may be mentioned that during the whole of the seventeenth century the production of copper at Falun averaged 1,760 tons, and that the value of the whole production of copper from this mine from the middle of the 13th century up to date is estimated at more than $ 160 million.

Still the production of copper does not correspond to the present demand, which can be proved by the fact that in 1891 the import of raw and blister-copper was 380 tons against an export of 120 tons, and the import of forged, rolled, and cast copper amounted to 600 tons, while the export was but 30 tons.

The imported copper, as well as most of that produced in the country, was used partly by the mechanical workshops, which consumed 150 tons, and partly in the manufacture of brass of which 300 tons were produced at the works of Skultuna, Torpshammar, and Gusum. Moreover a quantity is manufactured into plates, wire, and tubes at Skultuna and Granefors, besides that which is used in different trades by copper-smiths and braziers, for cooking-vessels, etc.

Copper was formerly often determined by the so-called »Swedish copper test» which with pure ores was tolerably adequate. The process was this: when the ore was diluted in a mixture of muriatic or sulphuric acid and nitric acid, and the liquid had evaporated, the copper was precipitated upon a clean-filed iron-rod from the diluted and boiling solution. The solution being free from copper, it was poured off and the copper was washed with boiling water, after which the loosely adhering copper was washed off from the iron and, after quick drying, either directly weighed as metal, or after oxidizing in a porcelain crucible, determined as oxide or sulphate. In addition several other methods have been in use, as precipitation with hyposulphite of soda from a boiling sulphated solution and determining as oxide, or sulphate; or titration of an ammoniacal solution with cyanide of potassium, etc.; but nowadays as a general rule precipitation of the copper in the electrolytical way is adopted. For determining very small percentages of copper in iron, etc., the coloration-assay of Professor V. Eggertz is also used.

Zinc. Metallic zinc or any preparation thereof, is not produced in this country, though an ample store of ores is not wanting. The ore consists exclusively of sulphuret of zinc or blende which, as such, is purchased by foreign markets. At the incomparably largest deposit of zinc-blende, Ånmeberg, owned by the Belgian company Vieille Montagne, the ore is calcined before being exported. Thus in 1891 there were 23,400 tons of blende calcined from which were obtained 21,700 tons of roasted material.

Nickel ores are certainly found at several places together with magnetic pyrite in so large a quantity that they have been formerly worked, but the mining of these ores has ceased of late years. The process of producing the nickel at the two nickel-works of Klefva and Sågmyra much resembled that of the old copper-smelting process, in eliminating most part of the sulphur, arsenic, and iron by repeated calcinations and smeltings, and then by pooling, roasting, and reduction with charcoal, finally producing the so-called powder-nickel. In 1891 in this way at Klefva 25 tons concentrated material were produced from 370 tons of roasted regulus. From this 14 tons of refined metal were obtained which, in reduction, gave 12 tons of powder-nickel with a proportion of about 68 per cent metal.

Cobalt occurs, though sparingly, at several places in the country, as at Tunaberg, Vena, and Gladhammar; in 1891 at the place last named alone there were 250 tons mined. Besides the above mentioned places, cobalt occurs in remarkable quantities together with copper ores, at Håkansboda, Riddarhytte, and Bäsinge mines. In smelting these ores, the cobalt, together with the iron and

some copper, is deposited at the bottom of the furnace, constituting what is called »nasar» (bears, horses), which in later times has given rise to the extraction of the cobalt and copper by the wet process, by dissolving them in diluted sulphuric acid and then precipitating both the metals. In this way 6 tons oxidul of cobalt were produced during 1891.

Gold is extracted almost exclusively at the copper-works of Falun from the residues of the ores; silver and copper having previously been extracted. Besides in certain working-rooms in the mines of »Stora Kopparberget» — where the gold occurs native, impregnated in quartz accompanied by selen-bismuth — it is also a constant ingredient in the whole stock of ore, as well in the silicious copper-pyrites as in the mundic, to an amount of 5 grammes per ton (0·0005 per cent). After the silver and copper have been extracted from the carefully calcined ores, the residue, chiefly consisting of quartz, silicates, and iron-oxide, is treated with a diluted solution of chlor-calcium mixed with some acid, on purpose that the solution may contain free chlorine by which the gold is dissolved (Munktell's process). After washing, the gold is precipitated with ferro-sulphate and lead-acetate. The old goldmines of Ädelfors which were given up after 1874, have been worked in 1891 by a foreign company. The whole production of gold in this country amounted in 1891 to 109·58 kg., whereof 107·2 kg. was from the copper-works in Falun.

For the determination of gold in iron- and copper-pyrites and in silicious rocks, Plattner's testing assay is used. After the ore has been previously completely calcined, 300 gr. are weighed, which, in a slightly moistened condition, are exposed to the influence of chlorine gas, after which the gold-chloride is worked out with chlorine water. After the chlorine has been eliminated by evaporation, the gold is precipitated with ferro-sulphate, collected on a filter, and after the burning of this, refined together with some silver and lead on a cupel of bone-ashes, after which the silver is dissolved in nitric acid and the residual gold weighed. In copper, regulus, etc., the gold is determined by dissolving these in nitric acid cupellation, and refining of the residue as before.

Silver. The production of silver and lead is nowadays undertaken only at Sala and Kafveltorp, where lead-glance containing silver is worked, and at the copper-extracting works of Falun, Åtvidaberg, and Helsingborg. The whole production in 1891 was 5,748·19 kg. silver, of which 123·74 contained gold. Of the above mentioned silver-works that of Sala takes the very first place. Its existence is dated from the end of the 15th century, since no available evidence can show how long before that time the production of silver was pursued there. The State has for many centuries supported the works with privileges consisting in grants of land and forests, and in the right to obtain wood and charcoal from surrounding parishes; in return, the State had the right to arrange and direct the works by its mining administration, which arrangement continued until the end of 1890. By this arrangement the State obtained in revenue the tenth part of the silver produced. In 1890 the mines and works were bought by a private company.

The proportion of silver in the pure lead-glance varies very much in different parts of the mine, and in different samples, or from 1·5 to 0·25 per cent. The percentage of silver has not shown itself to be in any way dependent upon the structure of the lead-glance, as more or less granular. On the average the proportion of silver is such that the produced work-lead contains 0·80 per cent of silver.

The yearly produce at Sala, which from 1400 to 1556 averaged 3,600 kg., has in recent times diminished to such a degree that in the later decades it averaged only 850 kg. of silver and 42 tons of lead. After coming into the hands of the new company, the production has again been augmented by the purchase of ores from other places and by better methods of enriching and smelting the ores. Thus in 1891 the production at Sala silver-works rose to 95 tons of bar-lead, 21 tons lead-ochre and 2,961·43 kg. of silver. Besides this, during the same time 66,300 tons of old residuals accumulated during long periods, have been treated on the wet method (Russel's) by which means 2,125·86 kg. of silver have been gained. At the copper-works of Falun, Åtvidaberg, and Helsingborg, the silver is a by-product obtained, as before mentioned, by precipitation from the copper solutions.

Silver is determined in ores, slags, etc., either by the so-called seething method or by smelting with carbonate of soda and cream of tartar in iron crucibles. In the seething test — which is used principally for slags and regulus, especially when containing copper and arsenic — 3 gr. of the pulverized material is mixed with granulated lead and smelted in muffle on a dish of refractory clay together with 1 gr. of borax, when part of the lead is scorified by the rich supply of air, and the oxide received by the molten borax. When so much slag is generated that it covers the lead, and no more oxidizing thereof takes place, the lead is cast in a mould, and then cupellated on a cupel of bone-ashes.

Lead is not produced except in combination with silver, and only at the works of Sala and Kafveltorp, where, in 1891, 290 tons refined lead and 10 tons lead containing antimony were produced.

Mining Schools. There are three institutes giving instruction in mining, one Higher, forming a division of the Technical High School in Stockholm (page 209), and two Lower Mining Schools situated in mining districts, the one at Falun, dating from 1822, the other at Filipstad, from 1830. In all these institutes the cost of instruction is defrayed partly by the State and partly by the Association of Iron Masters. The Association provides the cost of the practial instruction at the Higher School of Mines in Stockholm and with the State divides in equal parts the total cost of teaching at the Lower Schools at Falun and Filipstad.

DEPARTMENT F.

MACHINERY *.

The manufacture of machinery in Sweden during the last decades has shown a steady and relatively rapid progress, and the engineering shops are at present able to compete successfully in several branches with foreign establishments of high standing, as regards both working methods and the quality of the products, although they are of course still behind in quantity. This great development appears to be principally due to the extended use in the workshops of modern, improved machinery, especially machine tools — a good number of American origin — but is of course also in great measure attributable to the fact, that the works nowadays devote themselves more to specialties, than they used to do. But, although the progress in these directions still continues, it is much hampered by the keen competition, offered by the large industries of Great Britain and the Continent, and by the small consumptive power of the home market.

That, in spite of these unfavorable conditions, the Swedish mechanical industries rank very high among the various industrial pursuits of the country, is shown by the following extract from the official statistics. This extract comprises the number of *mechanical workshops and foundries*, the number of workmen, occupied in them, and the value of production (except the foundry produce, taken direct from blast furnaces at some of the iron works):

Year.	Workshops.	Workmen.	Value of production.
1870	92	5,100	$ 2,489,000
1880	209	8,750	5,749,000
1885	224	13,100	7,437,000
1890	214	15,800	10,121,000

While thus, during the last 20 years, the number of workshops has more than doubled, the number of workmen has increased more than three fold and the value of production more than four fold.

Out of the 214 workshops and foundries in 1890, 96 were situated in towns or boroughs and 118 in the country districts. Stockholm alone has 27 workshops, but the majority of them are of little importance; Gothenburg has 6, Malmö 3, etc.

* By Professor W. Hoffstedt.

Motors and apparatus for generation and transmission of power, etc.

Steam motors and *steam generators* are produced in Sweden of almost every size and description, from the small so called »colibri»-engines up to steam engines of large dimensions; from the single expansive engines to the compound- and triple expansion types, the engines being used for stationary, portable, locomotive or marine purposes. Boilers are used of almost every known type and variety. In the very last few years, a new type of steam motor has come to the front and rapidly gained an extended application viz. the DE LAVAL *patent steam turbines*, notable not only for great simplicity, small dimensions and cheapness of cost but also for low coal consumption and cheap and simple management.

There are no statistical accounts, regarding the production and use within the country of steam engines and boilers, but that both production and use have considerably and rapidly gained in importance, may be inferred from the fact only that while, about the middle of the seventies, the importation of these two articles represented a value of about $ 270,000, this value has decreased in 1891 to scarcely $ 120,000. The import and export in 1891 of different types of steam engines and boilers are as follows:

	Import.	Export.
Locomotives	$ 4,300	$ 13,300
Portable steam engines	47,300	6,300
Other kinds of steam engines	20,500	4,100
Boilers (separate)	44,100	6,800
Total	$ 116,200	$ 30,500

Out of the more prominent producers of steam engines and boilers, the following workshops may be mentioned:

ATLAS (stationary and marine-engines, locomotives); BERGSUND (stationary and marine-engines); BOLINDER (stationary engines, especially for the mining and wood working industries); LINDBERG'S SHIPYARD (marine- and stationary engines); all these workshops are situated in Stockholm. Further there are the GOTHENBURG Engineering Works and LINDHOLMEN (marine- and stationary engines), both in Gothenburg; KOCKUM in Malmö (marine- and stationary engines); MOTALA (marine- and stationary engines, locomotives); MUNKTELL in Eskilstuna (portable engines); NYDQVIST & HOLM, Trollhättan (locomotives) and others. For locomotives compare page 140.

Water motors. As the rivers of Sweden are rich in waterfalls, water power constitutes the motive element in a large number of works, especially within the mining districts, and the water motors, both waterwheels and turbines, have technically and economically gained a high degree of perfection. Among the workshops, where the manufacture of water motors is made a specialty, may be mentioned: ARBOGA Engineering Works; LINDAHL & RUNER, Gefle; VULCAN, Norrköping;

the FORSVIK Works; the SÖDERHAMN Engineering Works; the KARLSTAD Foundry, and others.

Gasengines are frequently used in the larger cities, but are not produced within the country; *wind motors* of American type are manufactured at the YSTAD Engineering Works, *electric transmission of power* in connection with water motors has come into use in several places (see page 183).

Appliances for transmission of power of modern types are manufactured at the KÖPING Engineering Works as a specialty and at most of the other mechanical workshops; *appliances for raising water,* almost exclusively in the form of pumps for waterworks, mines etc., are manufactured in no inconsiderable quantities at several workshops, as at BERGSUND, BOLINDER, LUDVIGSBERG, all in Stockholm, Gothenburg Engineering Works, KOCKUM in Malmö, MOTALA a. o.; *blowing engines and fanblowers* are manufactured at ARBOGA Engineering Works, LINDAHL & RUNER, Gefle; FORSVIK Works, a. o.; *cranes* and *hoisting machinery* generally are manufactured at most of the workshops; *brewing apparatus* is a specialty to the WIKLUND and the LUDVIGSBERG establishments in Stockholm (see page 60).

Boiler mountings and fittings of modern design and construction are a specialty to several workshops, as WIKLUND, Stockholm; HOLMBERG, Lund; SKULTUNA Brass Factory, Skultuna.

Apparatus and appliances for extinguishing fire.

Fire-apparatus, especially steam and hand fire engines, are manufactured in Sweden in large quantities, and this industry, so far as concerns the steam fire engines, has of late even been capable of competition in foreign markets. Thus the value of exported fire engines, principally worked by steam power, has averaged during the past five years about $ 10,000 to 14,000. The last mentioned manufacture is carried on at LUDVIGSBERG, Stockholm, and other more prominent makers of such appliances are J. R. HOLMGREN, Brännudden, near Vaxholm; the LJUSNE Engineering Shop; SÖDERBLOM'S Foundry in Eskilstuna a. o.

Machine tools and machines for working metals.

Tool manufacture in Sweden has of old its principal homestead in Eskilstuna, where, in about a hundred workshops with in all about 2,000 workmen, great numbers and varieties of tools for working metals and wood are yearly produced, and where, in general, modern working methods have been largely adopted. The declared yearly value of production from the Eskilstuna tool shops averages between $ 550,000 and $ 800,000. But the large foreign tool making establishments, not the least those in North-America, somehow have sueeeeded in finding a way for their produets to the Swedish market, while, on the other hand, a good quantity of Eskilstuna articles is yearly exported. *Machine tools for the metal working industries* naturally play an important part in an iron producing

country, like Sweden, and the large demand for such tools causes, that almost every one of the mechanical workshops devotes more or less attention to this kind of manufacture, some with marked success. At the KÖPING Engineering Works this branch of industry is a specialty.

Rolling mills for rolling the common forms of iron and also for rolling tyres and other specialties are made at several works, as at MOTALA Engineering Works; ARBOGA Engineering Works; LINDAHL & RUNER, Gefle; MORGÅRDSHAMMAR, Smedjebacken etc; this is also the case with *nailmaking machinery* and *horseshoe-nail machines*.

Machinery for the manufacture of textile fabrics and clothing.

Although the *spinning-* and *weaving-industries* occupy a high standing among the Swedish manufactures, the combined values of their production amounting to no less than S 15,000,000 in the year 1890, spinning- and weaving-machinery is for the most part imported from abroad, and very little of such machinery is supplied by the home workshops. On the other hand, the manufacture of sewing machines has rapidly increased and, in the year 1890, there were 3 sewing machine factories, employing together 600 workmen, and having a combined value of production of S 150,000. The most important of these manufactories is HUSQVARNA, near Jönköping, the excellent sewing machines of which have been much appreciated even abroad. Also *knitting-machines* form a part of the Swedish machine-manufacture, and are a specialty to J. E. ERIKSON, Stockholm, with a yearly value of production of S 35,000.

The *leather industries* with a value of production of S 1,350,000 in the year 1890, in common with the textile industries, as before mentioned, supply their principal want of machinery from foreign markets.

Machines for working wood.

For the manufacture of hand tools for working wood, compare below, page 175, concerning the tool making industry in Eskilstuna. Special kinds of hand tools are also manufactured at several other places as specialties, as, for instance, *saws* of all kinds at STRIDSBERG & BIÖRCK, Trollhättan. *Axes* are made in large quantities, partly as a manufacturing specialty, but partly also in the home-industry, which last mentioned method of employment is also productive of several other kinds of hand tools.

Wood working machinery of various kinds, principally sawmill machinery for steam- as well as water-power, of high perfection, are made at several of the mechanical workshops, as BOLINDER, Stockholm; ARBOGA Engineering Works, Arboga; LINDAHL & RUNER, Gefle; JONSERED, near Gothenburg, a. o. All machinery, used

in the important match manufactories (value of production more than $ 2 million) is also made within the country, as at G. Arehn, Stockholm; Siefvert & Fornander, Kalmar; Vulcan, Norrköping, a. o. This applies both to the match making machinery and to the match box machines. Compare page 157.

The *paper* and *paperpulp* industries form an important factor in the industrial pursuits of Sweden, the declared values of their production being for the year 1890:

Paper	$ 2,976,000
Paperpulp	2,251,000
Total	$ 5,227,000

The machinery, used in this production, is partly imported, partly made in Sweden, and machinery for making wood-pulp forms one of the specialties at several establishments, as at Nydqvist & Holm, Trollhättan; Forsvik and Hellefors Works, a. o.

Cork cutting machines are designed and manufactured by E. Boëthius, Stockholm. Compare page 61.

Machines and apparatus for typesetting, printing, etc.

Printing was introduced in Sweden a few decades after its first invention, and, in the year 1491, Stockholm was in possession of a stationary printing-office. At the commencement of the present century, there existed in Sweden (Finland then included) 35 printing-offices, of which 13 were located in Stockholm. Their number has since then been continually on the increase, as will be gathered from the following tabulated statistics, which also comprise the number of workmen occupied:

Year	Printing offices.		Workmen.
	Total.	In Stockholm.	Total.
1840	55	19	——
1870	136	26	1,200
1883	186	32	2,500
1891 (round numbers)	300	50	3,000

The first machine press was erected in Örebro in the year 1829, and since then their number has rapidly increased. So, in 1870, there were 91 machine presses; in 1875, 244; in 1883, 296, and in 1891 about 330. There are at present (1892) a number of 8 rotary presses for newspaper- and book-printing in use, besides 3 Lagermann's patent composing and distributing machines (so called typoteters) and 2 patent justifying machines by the same inventor.

Most of the printing machinery is of foreign make, with exception of the Lagermann machines, which are partly made in Sweden and partly abroad.

Type foundries were first established in Sweden in the earlier part of the 18th century. Their number in the year 1890 was 3, viz. P. A. Norstedt & Sons and Centraltryckeriet, both in Stockholm, and Berling's Printing Office

in Lund, with a combined number of workmen of about 100 and a value of production of about S 45,000.

Establishments for *stereotyping* and producing *clichés* by galvanic processes, etc., are found in connection with several of the more important printing-offices and also in the form of special industries.

Lithography, Zincography and Colorprinting.

Lithography is in Sweden, as in other countries, the most frequently used method of multiplying drawings. This art was introduced in the country about 1813, and has since then gained a comparatively high development. Although in Sweden several of the conditions are missing, which in other countries have given to this art a high standing, it may be asserted, that the progress in the different branches of this mode of reproduction has, in general, kept even pace with that in other countries. This is, however, less the case with regard to the *artistic lithography*, the more expensive products of which do not find a sufficiently remunerative market in the sparely populated country, than with regard to the lithographic reproductions, found in scientific and cartographic works, which deserve special notice, as being equal in perfection to the best, that may be found in similar works abroad. This appears to be especially applicable to the illustrations published by the Royal Academy of Sciences, and also to various school maps.

The number of *lithographic establishments* in Sweden in the year 1890 is stated to have been 19, with about 1,000 workmen and a value of production of about S 470,000. In Stockholm are found, besides several of less extent, the establishments of the Generalstab (The Staff) and of the Centraltryckeri. Also, in several of the other towns, this branch of industry is carried on on a large scale, almost exclusively for industrial and mercantile purposes, as in Norrköping, Jönköping, Malmö, Gothenburg, Örebro a. o. Out of these, the largest business is the Norrköping Lithographic Co., the largest lithographic printing-office in this country, also comprising a manufactory of paper boxes and various other articles of paper and millboard.

Zincography and *colorprinting* are practised in several of the establishments, above mentioned.

Photo-mechanical processes of illustrating etc.

The cooperation of photography with lithography, called *photolithography* and since long ago existing in other countries, has been in constant use in Sweden for the last 20 years, after an earlier, more temporary appearance. In 1873, by agreement with the State, the Generalstabens litografiska anstalt (the lithographic establishment of the Staff) was founded in Stockholm. This establishment, which, in all other respects a private business, has a kind of

semiofficial stamp about it, as being in certain respects under Government control, was erected partly with a view to promote the introduction of modern photo-mechanical methods of reproduction. And, in these efforts, the establishment has gained a great and recognized success, in so far that at present, besides the different methods of photo-lithography, the several kinds of printing surfaces, prepared by *photo-chemical* processes, *helio-engravings* on copper and the products of the *photo-gelatine* process, are extensively used in the common printing-offices. A very important application of helio-engraving is its exclusive use, since 1884, for the topographical maps, prepared and published by the Government. Besides at the important establishment, just mentioned, the photo-chemical methods have been most successfully applied by CEDERQVIST, SILFVERSPARRE, JÄGER and CENTRALTRYCKERIET, all in Stockholm (see page 220).

Miscellaneous handtools, machines and apparatus.

Appliances and machinery of this kind are not produced in any quantity within the country, except machines and apparatus for *washing, drying, mangling, ironing* etc., which are made at several of the mechanical workshops, and *cocks, valves* and various other *mountings for machinery,* which are manufactured at WIKLUND, Stockholm; SKULTUNA Brass Factory; HOLMBERG, Lund a. o.

Machines for working stone and clay.

The Swedish *stone industry* is carried on almost exclusively by manual labour, with exception of the brickmanufacture, where machinery has come into extensive use. The number of brick-kilns and manufactories in 1890 is stated to have been 300, with 5,500 workmen and a value of production of about $ 1,350,000; the machinery for this industry is made by MOBERG's Mechanical Workshop, Stockholm, and several other firms.

Machinery used in the preparation of food etc.

Of these classes of machinery, only *flour mills* and appliances, used in them, as *bolting* and *dressing machines* etc. are manufactured in Sweden at several of the workshops, as at BOLINDER, Stockholm; LINDAHL & RUNER, Gefle; MUNKTELL, Eskilstuna; JÖNKÖPINGS Engineering Works, a. o.

For *farming* machinery, see page 61; for *dairy* machinery, page 53.

DEPARTMENT G.

TRANSPORTATION — RAILWAYS, VESSELS, VEHICLES.

Railways, Railway Plant and Equipment*.

The Swedish railroads, of which the first line was inaugurated in the year 1856, had, by the end of 1892, grown to a *total length* of 8,673 kilom. or 5,386 Engl. miles. Their successive development from 1856 to 1892 will be seen from the figures given in the following table.

	State Railroads.	Private Railroads.	Total.	
	Kilom.	Kilom.	Kilom.	Engl. miles.
1856	32	34	66	41
1860	303	204	507	315
1870	1,118	590	1,708	1,061
1880	1,956	3,923	5,879	3,651
1890	2,613	5,405	8,018	4,979
1892	3,022	5,651	8,673	5,386

In comparison of the length of railroads with the number of inhabitants, Sweden occupies the place of honor among the European powers. If the area of the country is considered, the comparison will also be favorable for its southern half, this, the most important part of Sweden, being as well provided with railroads as many of the wealthier European countries. The northern portion, partly uninhabited and without the necessary means for supporting an extensive system, is of course far behind in regard to railroad facilities.

The *total cost* of construction of Swedish railroads amounts to a little more than 150 million dollars, averaging only 30,000 dollars per mile.

The entire *rolling stock* at the end of 1891 was composed of 896 locomotives, 1,928 passenger cars and 21,651 mail, baggage and freight cars. During the same year 13·64 millions of passengers were carried, each an average distance of 30 kilom. (19 miles); 11·23 million tons of freight were transported a distance

* By V. Klemming, Inspector of the rolling stock, and W. Wahren, Engineer at the State Railroads.

of 55 kilom. (34 miles) per ton. In other words: the railroad work amounted to 408 million passenger-kilom. and 618 million freight-ton-kilom.

The *gross earnings* amounted to $ 13·2 million and *the running expenses* to $ 8·2 million; the *net earnings* corresponded to about 3·5 per cent of the capital expended.

The private railroad companies, over a hundred in number, have received from the Government, as loan or subsidy, about 16 million dollars with occasional free grants of land for lines passing over Government land.

The State railroads are established according to joint resolutions of the Government and the Diet with money voted by the latter. They are managed by the *Board of Railways,* composed of the chief-officials of the four main departments, presided over by a Director General. The board establishes the regulations for the service in all interior matters; the general rules concerning the relations to the public, including passenger and freight tariffs, are given by the Government; the director has, only in certain cases, the right to alter the passenger and freight rates.

The private railroad companies must apply to the Government for concession in order to obtain right of way and protection for their property and must conform to the same general traffic rules as the State roads. In regard to freight and passenger rates, the Government fixes the higher limits only. Concerning certain details of the train service, of the rolling-stock and track special regulations are established by the authorities of the State railroads. Every private company has its Board of directors, chosen by the stockholders from amongst themselves. In case of loan or subsidy from the Government, one of the directors is nominated by the latter to protect the State interests. The working of the road is generally in charge of a traffic manager, elected by the stockholders or by the directors.

Railroad building has been a relatively easy task in Sweden, owing to the favorable character of the surface of the country, the whole southern part of it, with the exception of Småland, as far north as 60°, being rather level. The railroads, starting from the fertile plains of the southernmost province run northwards on both sides of the big lakes Vettern and Venern, and extend into the mining districts of Nerike, Vestmanland and Vermland, to the Norwegian frontier on the western side, and, by the eastern system, south and north of Lake Mälaren, through the capital into the northern provinces. From the station of Storvik the State trunk line continues alone its way northwards, on the slope of the highlands towards the Gulf of Bothnia, but at a considerable distance from the coast. Branch roads, creeping along the banks of the river valleys, unite the cities on the Gulf directly with the main line. At Bräcke the line is divided, one branch still keeping to the north, the other going westwards, winding its way through the mountain regions of Jemtland and climbing steadily uphill toward Storlien on the boundary line between Sweden and Norway, where it reaches its highest point at an altitude of 600 metres (nearly 2,000 ft.) above sea level. From here it is con-

tinued by a Norwegian railroad to the seaport of Trondhjem and, together with the branch Sundsvall-Ånge, forms an important direct line of communication, 465 kilom. or 289 miles, across the Scandinavian peninsula. The northern road from Bräcke is completed only as far as Hällnäs (905 kilom. from Stockholm), but it is expected that the remaining section to Boden (Luleå), about 250 kilom., can be opened for public traffic in the course of the next year (1894). At Boden it will connect with the northernmost railroad in Sweden and in the whole world, running from the seaport of Luleå up to the Gellivara iron-ore mountains, 75 kilom. (47 miles) north of the Polar circle. This road has been in operation for a couple of years and may be considered as the end-piece in the continuous string of railroad of a length of about 2,000 kilom. (1,250 miles), that passes from South to North through the whole length of Sweden.

The Swedish railroads were surveyed and built in a thoroughly economical manner. The State roads without exception, and 70 per cent of the private roads, have a standard width of 1·435 metres or 4 ft. 8½ inches; of the remaining portion about 1,000 kilom. were built to a gauge of 0·891 m. and about 700 kilom. to gauges varying from 0·6 to 1·272 m.; all lines have single track. The gradients are generally easy, the maximum being 1 : 100 for the larger part of the State roads; 1 : 60 is allowed only west of Östersund and north of Långsele. The smallest curves have a radius of 300 m. (about 1,000 ft.). The private roads have in a few exceptional cases gradients as steep as 1 : 40, but generally 1 : 80 is considered as the maximum. The smallest radius for curves is seldom less than 300 m., but is occasionally diminished to 240 m. for standard gauge and 120 m. for narrow gauge. The width of the top of the track varies from 4·3 to 6·0 m. for standard gauge and from 3·1 to 3·8 m. for narrow gauge, with a side-inclination in the proportion of 1 : 1·5 on the banks as well as on the sloping sides in the cuts. The thickness of the ballast varies from 0·4 to 0·6 m. for standard and from 0·3 to 0·45 m. for narrow gauge. The open space through rock is cut to a width of 4·75 to 5·4 m. for standard gauge and from 3·6 to 4·2 m. for narrow gauge.

The *sleepers* are of pine, cut in winter time of best quality and not impregnated. Their length is 2·4 to 2·7 m. for standard gauge and 1·4 to 1·8 m. for narrow gauge, spaced 0·75 to 0·89 m. apart in the first case and 0·6 to 0·7 m. in the latter. The *rails* used by the State roads are manufactured in Sweden of Bessemer or open-hearth steel, and weigh 34 kg. per m. (22·8 lbs per ft.) for lines south of Storvik and 27·5 kg. for those of the northern section. The private roads have lighter rails, weighing 17 to 27 kg. per m. for standard and 10 to 17 kg. for narrow gauge, and which are in most cases imported from Germany or England, where the prices generally are somewhat lower than in the Swedish mills. The rail-joints are all suspended and strengthened by fish plates of angular section, the rail ends secured by bolts. The rails are attached to the sleepers by spikes only, no log-screws being used.

The *drainage* is provided for only by means of open side-ditches in the cuts.

In places where the soil contains clay or other impermeable earths, it has been found necessary to excavate to a depth of from 1·4 to 1·8 metres and fill up the space with cinders or other material, that will let the water through, and to arrange covered ditches below the open ones to get rid of it entirely; otherwise, the water would freeze in cold weather and raise the ballast and the whole track.

All over Sweden smaller or larger rivers are encountered and have to be bridged for the railroads, especially so in the North. Owing to the surface of the country and the direction of the road, the latter must cross every river that descends from the mountain chain eastwards to the Gulf. For this reason there is a succession of *Bridges*, generally fine truss-girder structures, all executed by Swedish manufacturers and of Swedish material. Among these may be mentioned some of the largest. — The Dal River bridge at Krylbo contains 5 spans, the widest measuring 47·5 m., built on high latticed iron pillars. — The Ljusne River bridge has 3 spans (each 60 m.) and continuous lattice girders (top and bottom-flanges parallel). These were completely rivetted together on the shore and drawn across over the pillars in 20 working hours. Total weight 510 tons. — The bridge aeross the Ångerman River is the longest and highest of them all, measuring about 370 m. (over 1,200 Engl. ft.) between abutments, with the rail 46·5 m. (or 152·5 ft.) above low water level, built on the Cantilever system upon steel trestles in 5 spans, of which the central one is of 76·4 m., erected without falsework by overhang from each end. The whole structure weighs 626 tons. The material in this, as in all the other modern bridges, is mild steel manufactured by the open-hearth process. — The next highest of these bridges is to be found on the Öre River, where the rails are 43 m. above low-water. The bridge is divided in 4 spans, measuring 16, 47·8, 53 and 52 m. respectively; the girders have straight top and parabolic bottom-flange of 8·64 m. maximum depth; the height of the steel trestles varies from 10·74 to 35·3 m. Total weight 350 tons. — The Ume River is spanned by 3 sets of »bow- and string»-girders (panels 5·3 m. wide), each measuring 61 m. and resting on stone pillars. Weight 360 tons. — Over the Vindel River is a bridge of the same design as that used over the Öre, but somewhat lower, standing only 34·4 m. above low-water level. It has 3 spans, one of 30 m. width and 2 of 62 m. each; the trestles vary in height between 18·43 and 25·4 m. Weight 460 tons. — The bridge over the Lule River, the last in the long list, is made up of 3 spans upon stone pillars. The central girders, 62 m. long, with parallel top and bottom-flanges, were built out piece by piece by overhang to 20 m. from each side, the ends resting on temporary staging poles and connected to the end girders during the ereetion.

Small bridges are built of plate girders or rolled beams upon granite abutments. Wood was never but exceptionally used for this kind of work and only on narrow gauge lines.

The *Tunnels* are not numerous and are all very short, the longest being only 433 m. and passing through the hill upon which a portion of the capital is situated. Lining is nowhere used except at the mouths, where ornamental masonry was

deemed appropriate. No special arrangement is made concerning lighting or ventilation.

The *Switches* used by the State railroads are all manufactured in a factory belonging to the road and especially fitted for the purpose. The tongues have a length of 5·7 m. for the angles in use (for wider angles the tongues will be shorter). One of them is straight and the other curved to a radius of 240 m., corresponding to a crossing angle with tangents $^1/_{10}$ or $^1/_9$. The frogs are cast of open-hearth steel and made top and bottom alike, so that they can be turned over and both sides be used for wear. The switch with its stand is mounted upon 2 solid bedplates well braced together.

All railroad lines are protected by *fences* of strong horizontal wooden ribs, 3 or 4 above each other, nailed to wooden posts, 1·2 m. high, spaced about 2·4 m. apart.

The *Stations* are arranged in a very simple manner. The small ones contain only 1 or 2 side tracks, parallel to and at both ends connected with the main track, permitting the trains to cross or to pass each other. The larger yards are laid out on the same principle, the side tracks being only increased in length and number. The stations are also provided with a freight store house and a loading quay. Only the most important stations as Stockholm, Gothenburg and Malmö have separate freight and passenger depots. The station houses are built of wood or brick in a very plain style and in size limited to the strictest necessity, containing, besides the offices and waiting rooms, lodgings with dependences for the employees of each place. Locomotive round houses are to be found at a great number of stations and provided with balanced steel-turntables, 12 to 15 m. long, and water-tanks with posts of suitable designs, some of them having heating arrangements to keep them from freezing.

For the *maintenance of the track* only very simple tools are used, as rail-hammer, wrench, spade, pinchbar, pick axe and a long ironshod lever with chain and hook, the latter to be applied under the railfoot. With these means it is possible for a single man to raise and repair the track in any damaged point. This maintenance is executed by the regular trackguards or special gangs, no contract work being used in this particular case. The methods for keeping the snow off the road are very satisfactory, snow fences being erected, wherever snow drifts are expected to give trouble. These fences are generally put up at a distance of 15 to 20 m. from the track, to a height of from 2·4 to 3 m., and are composed of rather thin boards. To clear away the snow that falls on the track, *snow-plows* are used. Small snowfalls are cleared from the rails by plow blades, attached one to each of the guard-irons of every locomotive. In very deep snow, big plows of the American style, carried upon their own wheels, are pushed through by the necessary number of locomotives at as high speed as possible. Rotary-plows have not yet been considered necessary.

For the maintenance of track and *protection of trains* between stations there

is a special body of track-guards stationed singly at short distances from each other all along the road, and ordered to be on duty any time of the day or the night, whenever trains are to pass over their sections and to post for each train and show suitable signals. Each one of these men must go over his section (3 to 5 kilom. in length) three times a day on foot or by small handcars. They are controlled by trackmasters, whose sections vary from 20 to 30 kilom., and are to be inspected from end to end once every day. All stations communicate with each other through the electric telegraph, replaced in a few rare cases by the telephone. For signals the common optical system is employed with semaphores and discs, supplemented by flags, hand-signal lamps and, on the rails, by explosives. Accidents are almost unknown, and have not been fatal but once or twice during the 38 years that railroads have been in operation in Sweden.

The rolling-stock of the Swedish railroads had until very recently much the same general features as on the English and German roads. The first equipment was imported from England and the types copied by home manufacturers. Later, at a time when there was needed for the State railroads a large addition that could not be supplied in time by the works in Sweden, a considerable number of engines and passenger cars were bought from Germany, these afterwards for a number of years serving in their general details as models for reproduction in the country. This was particularly the case with the passenger cars, but the German style was introduced also for freight cars and remains still in use. The locomotive designers have throughout adhered more to the English patterns, but in the last ten years American ideas have been steadily gaining ground — particularly for express locomotives. The same is the case for passenger cars, so that the most modern passenger equipments on the State roads as well as on the leading private roads have lost their purely European features and in reality bear a closer resemblance to what is seen on the roads in the United States of America. Properly speaking a purely Swedish system does not exist, still the designers, having borrowed from the railroad features of other countries what has been considered best adapted for the purpose aimed at, have by happy combinations succeeded in creating a strong and efficient rolling-stock, well suited for the service of the country. It is supplied entirely by native establishments.

The express and passenger trains are drawn by *locomotives* with 2 coupled axles weighing in all 33 to 40 tons without tender, the latter having a weight of 20 to 30 tons. The interior heating surface of the locomotives varies from 78 to 102 sq. m., the cylinders have a diameter of 0·395 to 0·420 m. by 0·560 stroke and 1·880 m. driving wheels as maximum. The most recent express locomotives for the State roads are of the 8 wheel pattern and include all the essential American features, the barframe excepted, here replaced by rolled plates. Steel castings and pressed steel plates are largely used throughout the whole engine particularly in the truck and framework. The boiler is as large as possible within the limits of the stipulated weight on drivers of 26 tons. The leading

truck carries 14 tons. The tender is supported by 6 wheels and has a weight of 30 tons including 14 tons of water and 3 tons of coal. The total weight of engine and tender ready for service is 70 tons. The freight locomotives are of simple design, very plain in regard to finish and relatively light (grades and curves being generally favorable) not exceeding the weight of 36 tons on 3 pairs of drivers. Leading truck is not deemed necessary. The cylinders, outside of the frames, have a diam. of 0·450 m. by 0·560 m. stroke. The driving wheels measure 1·386 m. The tender, upon 2 axles, has space for 9·5 tons of water and 2·5 tons of coal, and weighs, fully loaded, 22 tons. For the narrow gauge roads where the traffic is carried on by mixed trains only, run at fair speed and obliged to stop at every moment, the American Mogul-type is found to be the best adapted for this kind of service, as it combines great tractive power with steadiness, and is easy on the track, very lightly built on this class of roads. The details are somewhat modified according to the ideas of Swedish locomotive builders. The weight of the narrow gauge engines varies from 12 to 25 tons; separate tenders are but seldom used. The water is carried on the engine in saddles or sidetanks; the coalbox is overhanging back.

As the railroads for very long distances run through forests of pine, very dry in certain seasons, it has been a necessity, in order to prevent fires, to provide the locomotives with means for *arresting the sparks,* that otherwise would be thrown out from the smoke-stack. After unsuccessful trials with a number of foreign patents, the officers of the mechanical department of the State roads undertook to solve the question by means of experiment and at last found a device that has proved itself perfectly safe in the most exacting circumstances. It is applied to nearly every locomotive in the country. It consists of a cast-iron chamber of conical shape, the smallest diameter downwards, mounted at the foot of the smoke-stack on the top of the smokebox, having generally its lowest parts projecting inside the same. The interior of this spark arrester is arranged with stationary wings, giving to the combustion products a whirling motion so that the sparks are dashed against the walls and ground almost to dust before they have a chance to pass out in the air through the open stack, when they are now too small and too cool to do any harm. The exhaust pipe is drawn through the system of wings, so that the steam from its nozzle is discharged directly in the open part of the stack.

As *fuel* is used bituminous coal of rather good quality. Only a minor quantity of it is mined in the country, the largest part being imported from England. Trials are going on to produce a cheap and good fuel for locomotives by coking peat, of which Sweden has immense quantities, but the results have not yet been entirely satisfactory.

Concerning the working methods of the Swedish locomotive works, it may be mentioned, that standard templates and gauges are used to a large extent so that similar parts in the different locomotives of the same class are perfectly

interchangeable. Details of the running gear etc. are kept in stock by the roads, so that broken or worn out parts can be replaced quickly without keeping the engines from service very long. This method has been also recently applied to boilers. The materials used for the principal details of the locomotives and tenders are as follows:

Boiler-shell: mild open-hearth steel or charcoal wrought iron; Firebox: copper; Flues: iron or mild steel; Frame-plates and Tank-plates: Bessemer or open-hearth mild steel; Wheels: wrought iron or steel castings sometimes cast-iron (for narrow gauge); Tires: Bessemer steel; Axles: open-hearth, Bessemer or puddlesteel; Springs: open-hearth steel; Axle boxes: brass, phosphor-bronze, cast-steel or cast-iron; Running gear: mild open-hearth or Bessemer steel (forgings or castings).

The *passenger cars* are all as a rule built on the intercommunication system. They are divided into compartments accessible from a common corridor running at one side the whole length of the car. The entrances to the corridor are at the ends from platforms protected by strong iron gates and sheet-iron fences. Flexible iron bridges connect the platforms of adjoining cars. Thus perfect circulation (for the passengers as well as for the train-employees) is secured from end to end of the whole train, without sacrificing the compartment system, much appreciated by the travelling public. The passenger cars are generally provided with waterelosets and lavabos. The newest cars are carried on 2 trucks (4 wheel) and have a length up to 18·2 m. and a maximum weight of 28 tons. The short cars on 2 axles have a length of 8·5 m. and a weight varying from 9 to 12 tons. The cars are built upon floor frames of channel or double T-beams, well trussed and made strong enough to carry the whole weight of the car.

The State railroads have 3 classes of passenger cars. The first class is limited to some express trains only and generally very little patronized, giving a reason for the tendency to do away with it entirely on all lines, as has been done in the North, and on the greatest number of private roads. The night expresses carry sleeping cars of first and second class, where a berth may be obtained for the small additional sum of S 1·35 and 0·80 respectively.

The *heating* of the carriages on all Swedish lines is done — with very few exceptions — by steam, furnished by the locomotive boiler for express trains and by a special boiler in the baggage car for the mixed trains, or by a combination of both, when the cold is excessive and the trains unusually long, as it has been found that steam cannot be carried to advantage for heating purpose for a length of train exceeding 100 m., when the outside temperature is lower than 15° Celsius below zero. Owing to the great differences of temperature, the problem of proper heating, combined with good ventilation, is a very difficult one for Sweden. Many systems have been tried during the past 20 years but none has given absolute satisfaction; still, improvements are constantly introduced and final success may be expected before long.

The *lighting* of the passenger cars for express trains on the State roads is done

by oil gas. Candles are used in the rest of the trains on the State road. Electric light (on trial in State road carriages) is successfully used in the cars of private trunk-lines, the current being produced by storage-batteries in the baggage car. Kerosene lamps are very common in the cars of the private roads.

Continuous power *brakes* are applied to the express equipment of the State roads as well as of some of the private roads. The only systems used are the Körting or the Smith-Hardy's automatic vacuum brake, prefectly interchangeable. The most recent locomotives are provided with steam drivers brake — besides the regular vacuum arrangement on the wheels of the tender. The Heberlein friction brake is mounted on a few trains in mixed service. Otherwise handbrakes only have to be relied on.

The *freight cars* are nearly all built on the European plan for 2 axles with a carrying capacity of 7 to 11 tons and lengths from 5·6 to 7·7 m. Special iron ore cars (for the Gellivara service exclusively) have 3 axles and carry 25 tons. Some narrow gauge companies have recently adopted long freight cars of the American style on 2 trucks particularly serviceable for the lumber and the charcoal trade. These cars have a length of 12 m. and will load 14 to 16 tons. The use of wood in the construction of freight cars is limited to a few parts only, as sides, doors, roofs and flooring. The body framework as well as the floor frames are all made of rolled channel-beams, double T or angle iron with iron bracing. The freight cars have various shapes according to the matter they are intended to carry, as for logs, lumber, charcoal, ore, lime, grain, dairy-products and fruit, stock and general merchandise. Special attention has been given to cars for the carriage of butter, this article being one of the principal export matters and liable to be spoiled by either heat or cold, thus losing its high market value. For this reason the cars are arranged to be cooled by ice during the hot season and heated by steam in cold weather. These cars are also used for fruit, vegetables, eggs, cheese and similar articles needing protection from heat or cold.

The car axles are forged of open-hearth or puddled steel; the carwheel-centres, of a spoke pattern, are made entirely of wrought iron with the tires of bessemer-steel shrunk on and secured by safety fastening rings. Chilled cast-iron wheels are used by narrow gauge roads for freight cars, not supplied with brakes. The springs are of best open-hearth steel. All standard gauge cars are provided with 2 spring buffers at each end, continuous drawbars with hooks, coupling screws and safety chains, on the general European plan. The narrow-gauge cars have only a central buffer combined with vertical self-coupling hook, to be uncoupled by hand.

The average annual mileages run by the different classes of rolling stock are for locomotives 30,000 kilom. (18,600 miles), passenger carriages 50,000 kilom. (31,000 miles), box-cars 20,000 kilom. (12,400 miles), and open flat cars 11,000 kilom. (6,800 miles).

Shipping, Shipbuilding etc.*

In the present century, the gradual development of the shipbuilding art into one of the greatest industries has deprived the types of the oceangoing vessels all over the world of almost every sign of national character, and, nowadays, even an expert may be deceived in trying to discriminate at a hundred yards distance, which among three different sailing barques is built in Nova Scotia, which on the Adriatic shore and which at one of the Swedish shipyards in the Baltic. As to steamers, even the keenest eye will be at a loss to determine, only by the form and equipment, the birthplace of one of the large cargo carriers, now building.

If, thus, there is very little to distinguish the Swedish seagoing ships from those, belonging to other nations, the small coasting, lake and river vessels afford a great variety of peculiar types, some of which are admirably adapted to their special purposes and, like the kayak of the Greenlander, seem to be the final result of centuries of experience in man's struggle with wind and wave.

As regards the simplest means of communication on the inland lakes and rivers, the canoe, chipped or burnt out of a single trunk, which no doubt in Sweden as well as in all other countries formed the first boatlike means of transport, is now only to be found in the public museums. The simplest boat, now commonly used in Sweden, the »*ekstock*», is a flatbottomed craft, consisting of boards, nailed together, and with square head and stern, bearing about the same general appearance as the common square ended punts on the English, Continental and American rivers. The very name of this craft, »ekstock», which means simply oaktrunk, seems to signify, that this form of boat is the first improvement on the original canoe.

Fishing and coasting vessels. The vast extension of the Swedish coast along the waters of the Baltic, the Kattegat and the Skagerack and the different character of different parts of the coast have given rise to several types of fishing and coasting vessels, each type adapted to the special requirements of its service. So, on the western coast, open through Skagerack to the gales of the German Ocean, we find the »*Koster*» *boat* — so called from the Koster islands —, used exclusively in more or less modified form for purposes of fishing and of transportation. Broad and full in form at and above the water line, this boat is deep and sharp almost like a modern racing yacht below water, and thus unites in a very successful way the properties of a good and safe seagoing fishing vessel, which, if wanted, may take a considerable cargo of fish to the next port, and of a good cruiser, able to fight its way through almost any of those gales, for which the Skagerack is in bad repute. These boats are built in almost every size up to 20 or 25 registertons and are of course all decked. A modification of the type, the »*bankfiskefartyg*», used in the high sea fisheries on the Dogger Banks, and other places, is a still larger vessel,

* By A. Isakson, Surveyor to the Society of Lloyd's Register of Shipping.

usually ketchrigged, which will sometimes measure more than 100 tons. As to the sailing qualities of the »Koster» boats, it may be mentioned, that those, built as pleasure yachts and pilot boats in the last years, have been found able sometimes to compete successfully with racing yachts of modern design, at the same time as they are much more comfortable vessels in a seaway. The great majority of these boats are built and fitted out by the fishing population, and then always clencherbuilt with oak planking, but recently some of the boatbuilding yards have built and fitted them in every way as pleasure yachts, and they are of course then built carvel.

Another of the national boattypes of Sweden is the »*Blekingseka*», extensively used on the south east coast. This part of the coast not being exposed to such severe weather as the western coast, the »Blekingseka» is built without a deck and depending for seagoing and sailing properties mainly on her high freeboard, great rake of stem and stern and light, elastic construction. Those specially used for fishing in the open sea will sometimes be found fitted with a single immense lugsail, hoisted on a loose mast, to which by means af loose shrouds is given a list to luff, the result being that the sail will have a tendency to lift the boat instead of, as usual, to press it, the more the list of the boat increases.

One of the »indigenes» among the Swedish boats is the »*Roslagsskuta*», an open vessel of sometimes up to 50 or 60 registertons, used on the east coast, in that vast archipelago, called »skärgården». These boats carry a large spread of sail on a low freeboard and are very convenient cargovessels with good sailing properties, but are not suitable for the open Baltic.

A peculiar craft on the east coast is the »*fisksump*», a vessel specially built for fish-transportation. She is a decked sailing vessel of sometimes up to 20 registertons, the after part of which, partitioned off by a watertight bulkhead, is in free communication with the outside water through a number of holes in the planking, and thus forms a good tank for live fish. The »fisksump» is usually rigged with a large mainsail, staysail and jib and will be found cruising across the Baltic in almost any weather.

Of *small boats* there is a great number and variety, most of them being the products of the home industry of the fishermen during the long wintermonths, and water sport is embraced with great interest all along the coast and on the large inland lakes. In the various yachtclubs and rowingclubs almost every description and type of modern boats are represented, from the tiny »single scull» to the magnificent »70 tonner», and even such a new type as the »fin-keel» boat is becoming familiar among the Swedish yachtsmen.

Merchant vessels. The following tables show the growth of Swedish shipping during the past fourty years. The last column represents the »carrying power» of the steam and sailing tonnages, taken together, on the usual assumption that, on an average, a steamer carries in a year 3 times the quantity of cargo which a sailing vessel of the same tonnage would carry.

Year.	Sailing vessels Reg.-tons.	Steam vessels Reg.-tons.	Total.		
			Number of vessels.	Registertons.	Carrying power tons.
1850	201,833	4,000	2,774	205,833	213,833
1855	223,292	8,000	2,874	231,292	247,292
1860	271,613	12,000	3,200	283,613	307,613
1865	253,605	13,900	3,155	267,505	295,305
1870	319,247	30,930	3,376	350,177	412,037
1875	424,042	92,968	4,237	517,010	702,946
1880	461,593	90,775	4,333	552,368	733,918
1885	406,910	110.151	3,968	517,061	737,363
1890	369,680	139,799	3,856	509,479	789,077
1891	377,667	152,493	4,160	530,160	835,146

For comparison, the simultaneous growth of the tonnage of the whole shipping of the world («carrying power» in tons) will be seen from the following figures, according to researches made by A. N. Kiær.

Year.	The World. Tons.	Sweden. Tons.	Sweden in per cent.
1850	8,039,600	213,833	2·66 %
1855	10,522,300	247,292	2·35 »
1860	13,006,000	307,613	2·37 »
1865	15,345,500	295,305	1·92 »
1870	17,479,900	412,037	2·36 »
1875	21,819,200	702,946	3·22 »
1880	27,204,600	733,918	2·70 »
1885	34,191,400	737,363	2·16 »
1890	37,689,200	789,077	2·09 »

As will be seen in the tables, the growth of the Swedish merchant fleet about 20 years ago not only kept pace with but even surpassed in rapidity the average growth of the world's shipping. On the contrary, the numbers for the last 15 years show a marked stagnation, which, when compared with the simultaneous growth of the world's shipping, appears to indicate, that this part of the national activity has in one way or other suffered from unfavorable conditions, as compared with the average activity of other nations in the same branch. The apparent rise in the number of vessels and tonnage of the last year (1891) is stated to be partly due to improved statistics, but it is to be hoped, that this rise also points toward another of the great *waves* of progress, culmen and regress, which generally characterize national development.

Shipbuilding. The great activity, which some decades ago was prevailing in the numerous dockyards along the Swedish coast, has since then gradually almost died out. Nearly all the yards on the shore of the Gulf of Bothnia are now closed, and, where twenty years ago the busy sound of hundreds of carpenters' axes filled the air and new-built, full rigged ships spread their fresh canvas to the winds,

scarcely a single keel is now laid, except perhaps for some little schooner or barge. At the wood yards of the South too, the activity has considerably decreased, and a few small barques, schooners and sloops, some of them for Danish account, are now the scarce occupants of vacant berths on the wood yards of that part of the country.

It is difficult fully to account for the falling off in this branch of industry, a falling off which is even more marked than the simultaneous decrease in wooden shipbuilding in the other great centres of that industry, viz: Nova Scotia, the United States, Norway, Italy and Austria, but one of the main reasons certainly is, that, iron and steel having gradually superseded wood as building material nearly all over the world, and improved types of both sailing- and steamvessels having been largely adopted, a great number of old foreign sailing vessels have been laid idle and then bought by Swedish owners at prices, far below the cost of building new wood vessels.

Almost the only exceptions to this deplorable state of things is the coasting- and river-fleet of small steamers, which has shown a marked progress both in number and quality, all the vessels being built and engined by Swedish shipbuilding yards and workshops. Also, in the latest two years, a tendency to a better appreciation of modern improvements in seagoing cargo ships has been noticed, in so far as recently a number of new such ships have been partly procured from England and partly built at the home establishments.

The declared number of shipyards etc. during the last two decades is shown by the following figures.

Year.	Firms.	Workmen.	Value of production.
1872	27	2,021	S 795,000
1875	31	2,041	902,000
1880	28	997	379,000
1885	25	1,273	470,000
1890	24	2,106	1,102,000

The activity at eleven of the principal shipbuilding yards may be estimated from the following figures, which give the total number and tonnage of vessels built during four semi-decades.

Year.	Vessels built.	Tonnage.
1871—75	283	37,817
1876—80	210	25,132
1881—85	232	53,688
1886—90	141	26,012

The most important of the Swedish *shipbuilding yards* are the LINDHOLMEN yard in Gothenburg; the KOCKUM Co's yard in Malmö; the BERGSUND Co's two yards at Bergsund and Finnboda Slip in Stockholm; BRODIN's yard in Gefle, now connected with the ATLAS slipway; the LINDBERG Co's yard in Stockholm; the

Motala New Co's yard at Motala, until recently united with the Lindholmen and Oskarshamn yards to one large company, the renowned Motala Co., which was then the largest shipbuilding business of all Scandinavia; further Keiller's yard at Gothenburg and the yard at Oskarshamn, all known as productive of large numbers of most successful coasting steamers and swift passengerboats, in model, fittings and equipment equalling any other structures of their kind afloat.

At all those yards are found more or less complete plants of modern shipbuilding and boiler constructing machinery, and such tools as hydraulic and pneumatic riveting machines for riveting boilers of the heaviest description, electric drilling machines, flanging machines, etc. are now growing into common use. Even large multiple drilling machines for drilling the rivetholes in marine boilers, when the plates are fitted in place, are coming into use, as being found indispensable for securing sound work in the heavy high pressure boilers, now fitted on board steamers.

Although the Swedish built vessels scarcely differ from those, built in other countries, this does not imply that no new inventions in shipbuilding and kindred industries are originated or tried in practice in Sweden. On the contrary, the spirit of *Samuel Owen, John Ericsson, Carlsund* seems to be still alive among the Swedish naval architects and marine engine builders. Tank steamers for carrying petroleum in bulk were built in Sweden at the Motala Co's yards for Russian owners, long before the first patent on this kind of vessel was applied for in England or America, and numerous essential improvements in marine machinery and appliances have been originated in Sweden. The small and swift open passenger steam launches, now running in every direction on the waters of Stockholm and there alone numbering about 60, were first built and engined in Sweden and have now been adopted in several foreign places. As a rule, they will take from 50 to 100 passengers each and are doing excellent service the day long through dozens of years without a hitch, at the same time contributing to give to the capital, its harbours and channels the lively and cheerful appearance, which so strongly impresses the foreigner. The new armourclads of the »Svea» type — upwards of 3,000 tons displ. — have been inspected by foreign naval experts of high standing and declared by them to be, when their low price (not quite $ 800,000, fully equipped and armed) is considered, almost marvels of handiness and efficieney.

The materials, used by the Swedish ship- and marine engine-builders, are, as a rule, manufactured at the Swedish steelworks, but the known superiority of the Swedish iron, which has almost grown a dogma, does not now play the same important part, so far as regards *ship- & boiler-material,* as it used to do. The general adoption abroad as well as at the Swedish steelworks of the Siemens-Martin open-hearth process has brought the result, that out of very inferior English and German ores is now produced a mild steel, which for ship- and boiler-purposes fully equals the material, now manufactured for the same purposes in Sweden from the pure Swedish ores. True, the iron and steel, manufactured

in Sweden, continues to hold its own still for many special purposes, and finds its way in large quantities to the foreign markets, but, at the same time, the comparatively high cost of producing from Swedish ores also the common mild steel for ship's bottoms has been a serious drawback on the Swedish shipbuilding industry of the later years, in so far that in most orders, given to the Swedish yards, the owners still continue their old custom of specifying for »Swedish material».

If the Swedish shipbuilders will in the future be able to compete in prices anything like successfully with their foreign colleagues, either the cost of producing Swedish ship- and boilerplates will have to be materially lessened, or the builders will be obliged to use foreign material in larger quantities than heretofore.

Thus, it cannot be denied that the Swedish yards can hardly stand the keen competition, offered by the large English establishments, as soon as there is a demand for a new vessel of somewhat larger size, but one of the principal reasons for this somewhat discouraging fact also appears to be the difference, that exists in the management at large of the shipbuilding industry in the respective countries. While, in England, a shipbuilder is, as a rule, *only* a shipbuilder and most frequently does not even build the engine and boiler, that are to propel the ship, the Swedish shipbuilders, with few exceptions, by reason of the character of their market, are not seldom obliged cheerfully to accept orders for things, widely different in nature from ships or marine-engines, and even the leading establishments have generally a *third* specialty, in addition to shipbuilding and marine-engineering. Where the British shipbuilder is thus enabled to devote all his interest and abilities to the one point, how to build a good and strong ship with the least possible expenditure of time and labour, and is, in addition, supported by cheap capital and the whole world as a market, his Swedish colleague has to rely in the struggle of competition only on earnest work, on his intelligent technical staff and his quiet, good-natured workmen, among whom, up to date, labour difficulties, of the kind so often prevailing abroad, have been something almost unknown. The simple circumstance, that these last mentioned factors have rendered it possible for the Swedish iron shipbuilding industry at large to exist and even, at times, to flourish, although of course not quite free from the calamities, that seem to be indispensable in all large branches of industry, speaks volumes of the men engaged in it, the leaders as well as the men in the ranks, and gives inducement to the hope, that, when the temporary depression in this industry, that now prevails all over the world, is once overcome, Swedish shipbuilding will continue to hold its own.

Harbours. There being no perceptible tides along the Swedish coasts, the harbours are not supplied with docks for berthing vessels, while loading and discharging, as in England, France etc., and this naturally makes a harbour much cheaper and good harbours much more frequent than in those countries, where high tides wash the shores. A Swedish harbour, as a rule, consists of one or more piers of wood or

granite, built alongside or projecting into the waterspace, which is usually sheltered by the configuration of the coast or by surrounding islands, and at the same time often has the advantage of a natural depth of water, sufficient for even the largest ships afloat. Only in the comparatively few places, where the coast is unprotected by Nature itself, special moles like those in England and on the Continent have been built to protect the harbours, the most important of such artificial harbours being those at Helsingborg, Malmö and Visby. The newly completed harbour at Helsingborg, which is considered from a Swedish point of view to be a grand piece of work, has a water area of about 21 acres, a depth of water of 23 feet and a length of quayage of about 5,000 feet.

The most important harbours in Sweden are those of Stockholm and Gothenburg, which, if the surrounding sheltered waters are included, would each be sufficient to give shelter and anchorage to all the assembled merchant ships and war vessels of the world. The total length of quayage in Stockholm harbour is 25,400 feet and the depth of water in the basins sufficient for any vessel afloat, but the depth at the entrance by fort Fredriksborg has been artificially decreased, in order to prevent large men of war to proceed direct to the capital, if they should be able, successfully to force their way past the fortifications. At the new part of Stockholm harbour, called the »Värtan», there are special arrangements for the speedy discharge of vessels, and it is no uncommon occurrence, that a coal laden vessel will there discharge up to 800 tons a day. Two special elevators for discharging grain cargoes are also erected in Stockholm, the largest one capable of discharging out of a vessel as much as 240 tons of grain in 24 hours.

Dry docks and slipways for repairing vessels are numerous, amounting to no less than 19 of the former and 17 of the latter kind. The largest docks are those at *Lindholmen* — formerly Motala Co. — in Gothenburg, dimensions 348 feet × 50 feet × 20 feet depth on sill, and at *Beckholmen* — belonging to the Society of Merchants — in Stockholm, dimensions 340 feet × 56 feet × 18 feet depth on sill. The most important slipways are the *Kockum Co's.* patent slip in Malmö, the *Finnboda* patent slip in Stockholm, both with hydraulic hauling gear, and the *Atlas* patent slip in Gefle, with wormwheel gearing, each capable of taking vessels up to 1,200—1,300 tons weight of hull. In Karlskrona, the principal Swedish navy yard, there are no less than 6 dry docks, the oldest one built by Polhem about two centuries ago; these dry docks are of course built exclusively for the wants of the Government, but also merchant vessels in distress may occasionally find a hospitable refuge, as well in the docks in Karlskrona as in the new Government dock in Stockholm, dimensions 302 feet × 59 feet × 22 feet depth on sill.

Salvage and diving appliances, etc. As above mentioned, no tides of any importance prevail in the waters, that surround Sweden, and this circumstance of course greatly lessens the risk of a grounded ship being wrecked by the tides, which so often happens on the coast of England and the Continent. The better chances of saving a vessel, grounded in the Baltic, and the comparatively large number

of vessels, that are annually damaged in the waters, that surround Sweden, have given rise to several salvage enterprises in Northern Europe, and the most prominent of them all is considered to be the NEPTUN Salvage & Diving Company of Stoekholm. This eompany was founded in the year 1870 on a paid up eapital of 400,000 dollars and has sinee then gradually developed by continued building of larger and more effieient salvage vessels, supplied with speeially designed applianees of the most elaborate deseription and manned by specially drilled officers and men. This staff of about 100 men, most of them trained experts, are always living on board the vessels, whieh themselves are usually kept with steam up, ready to start at a moment's notiee.

During its existence of 23 years, the Company's services have been requested not only on the home waters but also at distant foreign plaees nearly all over the world, the deelared salvages being as follows: 3 ironelads, 232 cargo steamers, 63 coasting- & passenger-steamers, 342 sailing ships, 580 sundry eargoes, representing in their salved, damaged state a value of 20½ million dollars. The running expenses are stated to average, for the last twelve years, about 165,000 dollars a year.

The *salvage plant*, now in use, consists of:

Seven steamers, speeially built and fitted out for salvage purposes. The larger of these boats are of about 700 tons displaeement on load line with dimensions of about 150 ft. × 25 ft. × 13 ft. and are fitted with propelling machinery of about 750 indicated horsepowers; five eentrifugal steam pumps, fixed in the steamers and worked by separate steam engines; these pumps are eaeh eapable of diseharging from 2,000 to 2,500 tons of water per hour; sixteen portable steam pumps of different sizes, with portable boilers and a diseharging capacity of from 300 to 900 tons of water per hour, the total diseharging capacity of all the steampumps amounting to 16,000 tons of water per hour; twenty diving apparatus of different sizes, some worked by steam and some by haud power, several of them being supplied with telephones, so as to establish a perfect eommunication between the diver, working below water, and the people on board the vessel; electric submarine lamps, worked by fixed dynamos on board the boats; eylindrieal iron pontoons of about 100 tons lifting capaeity eaeh. These pontoons are filled with water, and, after they have been sunk to the bottom and fastened to the wreek, the water is diseharged from them by air compressing maehinery, fitted on board the salvage boats. The plant is eompleted by submarine blasting machinery, pneumatic drills, ete., steam eranes, winehes, chains, towing cables, ete. of the heaviest deseription.

Besides this large business, several of the shipbuilding and repairing establishments keep speeially trained divers for effeeting repairs below water, and one speeial diving business, the STOCKHOLM Diving and Salvage Co has sueeessfully raised large quantities of sunken ships' eargoes and also some vessels of smaller size.

Pilotage, Light-houses and Life-saving Establishments.

The *Royal Board of Pilotage* is a branch of the Admiralty and embraces the Pilot-service as well as the Light-house and Life-saving establishments. The Board consists of one Director General as decisive authority and of two Chief secretaries, who prepare the affairs. The sea-board of the country is further organized into 8 districts, each of which is in charge of an officer of Commander's rank.

Pilot-service. The use of Pilots for vessels is optional. At the end of 1891 the number of pilot-stations was 168. The personnel consisted of 28 foremen, 569 regular pilots and 211 apprentices. At places of more importance the Government keeps larger, decked cutters for the use of the pilots, the smaller boats and skiffs having to be maintained by the pilots themselves. The pay of the pilots partly consists in unabridged shares of their pilotage and partly of a regular salary.

Light-houses etc. Omitting about 140 smaller harbour- and fishing-lights, kept by communes or private companies, there are on the coast 260 Government light-houses and light-ships, the total value of which amounts to about $ 1,800,000 as specified in the following table:

Order of light.	Number of lights.	Average value in dollars.	Mean range of light.
1st	4	28,800	17·7
2nd	13	24,500	16·8
3rd	22	16,100	15·1
4th	27	6,050	12·7
5 & 6th	27	2,440	10·2
Reflectors (larger)	13	14,600	15·7
Reflectors (smaller)	17	320	—
Lights without permanent guard	124	540	6·9
Lightships (not incl. 4 in reserve)	13	26,200	10·4

Mineral-oil is the illuminant used for all the lights. The illuminating apparatus of the larger lights resembles that in use everywhere else. The light-towers are built of stone, concrete, iron or wood. They are, as a rule, erected at such height on the shore or on the rocks, as to remain unaffected by the action of sea or ice. This arrangement partly explains their low cost of building, to which also contributes the circumstance, that the lodgings of the personnel are all built of wood. The walls of these habitations, which are peculiar to this country, are made up of 10 cm. double-rabbeted planks lined on both sides with impregnated pasteboard and rabbeted boards. This way of building makes the houses warm, free from damp and draught, and is well suited for the generally unprotected sites, where the pilots and light-house-keepers have to reside.

The Baltic and Cattegat being comparatively small waters with their coasts skirted to a very large extent by wide archipelagos of islands, rocks and shoals, no direct comparison can be obtained between the light-house establishment of Sweden and that of other countries. Our sea-coast may thus, e. g., in many cases be illu-

minated without inconvenience by lights of comparatively small power, which lights, situated at short distance one from the other, then also serve as directive lights for entering the passages. But also the waters of the archipelagos, which are frequented by the coasters, require their own illumination. National in its origin, as well as in its development, this system of illumination has altogether been brought into existence during the last twelve years. About 20 of these lights are provided with the VON OTTER occulting apparatus, invented by the former minister of the Navy and already described in the common literature on light-houses. Regarding the use of these lights the rule is followed, that their »clean sector», as seen from a vessel advancing towards the light on entering the archipelago, is limited on the »port» side by *single flashes of red light,* and on the »starboard» side by *double flashes of white light.*

In 1880 experiments were made with lamps invented to remain burning for some time without supervision, and the following year the first lights of this sort were established. The illuminant used was gas oil (naphta) purified for the purpose. This lamp is now everywhere substituted by lamps having burners invented on the constant-level-principle and which can be left burning for 10 days without trimming, their keepers, however, having, according to instruction, to visit the lamps once a week. The peculiarity of the lamp is the burner with its large wick-pipe, which is only partly filled with the wick. It was invented by G. W. LYTH in Stockholm. The illuminant now in use for this lamp is Russian petroleum, of which the consumption is about 0·05 quarts an hour.

In order the more easily to distinguish the lights of these small light-houses from other lights, their illuminating apparatus is surrounded by vertical shades or colored glasses, which are brought into rotation by the current of air ascending from the flame of the burning lamp, thus periodically eclipsing the light or changing its color. This improvement, called »rotator», is invented and patented by L. F. LINDBERG in Stockholm. The average cost of light with structure amounts, as shown in the preceding table, to about $ 540, the yearly expenditure for light with illuminant and keeper being about $ 66.

Fogsignals. Fogsirens, with sound produced directly by the action of steam, are established in 10 light-ships and at 5 lighthouse-stations. At 11 stations trumpets are used, one of which is worked by a petroleum-motor, the others by hand. At 11 places fogsignals are given by means of bell and at 11 others by means of guns with charges of 0·6 to 1·3 kilog. of powder.

Beacons, buoys etc. In order to facilitate the navigation on the coast by day, there are 409 beacons and stonework-marks or »cairns» erected. There are further 754 buoys or spindles and 3,258 small stakes laid out in the passages. These stakes merely consist of long spars anchored so as to remain upright. They are of two different classes: white and red, the latter with a »broom» at the top. As a rule stakes of the same class are placed on the same side of the channel, the stake thus marking the fairway, not the shoal.

Life-saving establishments. On the coasts of Sweden there are 18 stations for saving life in case of shipwreck. Of these 12 are provided with life-boats and 11 with rocket-apparatus. The older boats are of English and the newer ones of Danish model. From 1856, when the first of these stations was established, this institution has been the means of saving 1,421 human lives.

In connexion with the above statements, the following table, giving the total number of wrecks and stranding-accidents, which have occurred on the coasts of Sweden during the years 1863—1891, may, finally, be of some interest:

Years.	Small damage.	Considerable damage.	Wreck.	Sum of accidents.
1863—1870	427	119	454	1,000
1871—1880	1,020	277	529	1,826
1881—1890	1,280	333	468	2,081
1891	122	40	36	198

The *Nautical Meteorological Bureau,* started in 1878, and placed under the Swedish Admiralty is established so as to arrange and collect meteorological observations made during long voyages on vessels that belong to the Royal Navy or others. From the meteorological logs sent in, extracts are made at the Bureau concerning what may be of importance for Swedish navigation, after which the logs are sent to Utrecht, where they are used for international comparisons of observations made. It also devolves on the Bureau to diffuse the knowledge of the meteorological conditions of the Baltic, Cattegat, and the North Sea, and for this purpose it supervises both the meteorological and hydrographic researches carried on at the Swedish light-houses and light-ships. At some of the lighthouse-stations, daily observations are made concerning the height of the water, and automatic tide-gauges are used for this purpose at many places. Moreover the Bureau controls all compasses, tests meteorological and nautical instruments on behalf of the Royal Navy, and also gives advice, when requested, concerning the fitting out of private vessels with these instruments; for which purpose a collection of instruments of very newest construction is always accessible to the masters of vessels. The governing body of this Bureau is formed by the head of the Hydrographic Survey Office, that of the Meteorological Central Office, and the manager or head of the Bureau itself.

There are *Schools of Navigation* in Stockholm, Gothenburg, Gefle, Malmö, Kalmar, Hernösand, Visby, Karlshamn, Vestervik, and Strömstad, the aggregate number of pupils in 1892 amounting to 338. These schools are divided into two sections, that of Navigation and that of Engineering; from the former during the past years course 126 pupils passed their mate's examination and 74 that of master; while as regards engineering 55 passed as ordinary engineers and 32 as chief-engineers.

DEPARTMENT H.

MANUFACTURES*.

Chemical Products.

The manufacture of chemicals has developed very rapidly in Sweden of late years as is proved by the following figures.

Year.	Factories.	Value of product.
1886	98	$ 1,297,000
1887.....	106	1,377,000
1888.....	114	1,576,000
1889.....	123	1,992,000
1890	130	2,123,000

The above manufactories do not include those for matches, explosives, colors and varnishes, or starch. Among the many different branches of this large group, but a few are carried on to any large extent, though what is produced is considered the best in the market.

Sulphuric acid is prepared in Sweden in considerable quantities, though the export thereof is slight, since the greater part is used at home, not only in the preparation of superphosphates and the extraction of metals, but also in making nitric acid at those places where explosives are manufactured. The raw material consists mainly of sulphur pyrites. The chief seat of the preparation of sulphuric acid is the Scanian Superphosphate and Sulphuric Acid Manufacturing Co. in Helsingborg, which obtains its supply of sulphur pyrites from the Sulitelma mines in Lapland. The total output in 1890 was $ 191,000, while that of the import amounted to $ 20,000.

Among other chemical substances which are largely prepared caustic natron, carbonate of potassium, and alum may be mentioned.

Caustic natron is prepared in considerable quantities so that the prime cost in 1890 amounted to $ 35,000. The value of the export of carbonate of potassium in the same year was $ 3,200, that of the import being $ 179,000.

Alum is of great importance in certain technical processes, such as dyeing, tanning, the making of paper, etc. From time immemorial there have been

* By Professor G. Sellergren.

alum-works in Sweden, which from siliceous slates have produced alum both for home and foreign demands. Most of these works were however closed as they could not compete with the foreign ones using newer modes of procedure. In 1885, however, the SCANIAN SUPERPHOSPHATE Co. decided to take advantage of the clays of Skåne so suitable for this production, and the preparation of alum is carried on there according to a new method, and with a very fair result. In Skåne among the strata of the carboniferous formation there is (at Bjuf and Billesholm) clay-slate with more than 40 per cent of alumina (about 2 to 2·5 per cent of oxide of iron). By the roasting of the slate and proper chemical treatment (with acid sulphate) alum meal is obtained perfectly free from iron. The manufacture of alum has of late years greatly increased, which is shown by the fact that in 1885 the export was only one sixth of the import, while in 1890 the export more than trebled the import. The export took place chiefly to Denmark and Finland.

Aseptine is a first-rate preserving medicine which was in 1868 invented by the Swede Henry Gahn, having since then obtained a good sale all over the globe. It consists of boracic acid, which even in minute quantities acts as a good preservative for food. For the toilet so-called amykos is generally used, which contains certain additions. The value of the output of aseptine and amykos in 1890 was $ 35,000. — The *perfumes* and *soaps* now made in Sweden can fully compete with those made abroad, both as regards quality and price. The value of the output of soaps, in 1890, reached $ 618,000; the export had a value of $ 156,000. Of perfumes the export at present exceeds the import. The chief makers of perfumery and soaps are the BARNÄNGEN Technical Works, F. PAULI, HYLIN AND Co. in Stockholm and a couple of works in Malmö.

The manufacture of *stearine-candles* has reached a high state of perfection in Sweden (vide page 172). An important by-product of this manufacture is glycerine, which is chiefly used for the preparation of nitro-glycerine and explosives made thereof, but is also used for liqueurs, the preservation of fruit, as an addition to soap, etc. The output is now so large, that a considerable export is made.

Mineral Waters of different kinds are also manufactured in considerable quantities and the value of the output in 1890 was $ 162,000.

In the same year 46,588 kilog. (103,000 lbs) liquid *ink* was exported, as also 512,024 kilog. (1,129,000 lbs) vitriol. The Swedish writing ink has a very good reputation in the marts of the globe, chiefly owing to the fact that the products of the Barnängen Technical Works have several times obtained prizes when competing with those of other lands.

Explosives. The modern technics of explosives has enormously developed in Sweden. Alfred Nobel, a Swede, was the first who brought *nitro-glycerine* into extensive use, when, in 1863, he proved that by a quickly exploding detonator the explosion of nitro-glycerine may be brought about, and discovered a safe method for its preparation on a large scale. The use of this preparation is however open

to great danger, more especially in a liquid, unmixed state, so that its use is closely limited by law. The most usual form of nitro-glycerine is dynamite, which was invented by the aforesaid Alfred Nobel. *Dynamite* is a mixture of nitro-glycerine and solid, porous non-explosives as bone-dust, wood, or wood-pulp, paper, clay etc., in which compound nitro-glycerine is present to the extent of from 30 per cent (No. 3) to 75 or 80 per cent (No. 1). Mr Nobel has also introduced another explosive into use, called extra dynamite, which contains gelatinized nitro-glycerine, obtained by heating nitro-cellulose in nitro-glycerine. Extra dynamite is considered somewhat safer than dynamite.

Sebastine is another Swedish explosive invented in 1872 by Beckman, being afterwards improved by Falnehjelm, who named it New Sebastine. This explosive is composed of a mixture of nitro-glycerine, nitrate of soda, and charcoal.

Among other explosives, containing nitro-glycerine, invented in Sweden, *double ammonia powder* (invented by Wendin) and *Nitrolite* (invented by C. Lamm) may be mentioned. Two explosives not containing nitro-glycerine are also manufactured, viz. *Bellite* and *Romite*, of which the former is deemed not so susceptible to knocks and blows as those explosives previously mentioned and not exploding when heated to 260° Celsius.

The manufacture of *gunpowder* now takes place on a very extensive scale. The mills at Åker and Torsebro manufacture the powder for the Crown. The raw materials potash, charcoal, and saltpeter are certainly produced in this country but not in sufficient quantity.

In 1890 there were 6 manufactories for the making of explosives, viz. the Nitroglycerine Co. Lim., Stockholm (dynamite), the Gyttorp Powder Factory (ammoniapowder, dynamite), the Sebastine Co. Lim., Uddnäs, Kungsängen (sebastine), the Express-dynamite Co. Lim., Grängesberg (express-dynamite) and the Blasting-material Factories at Rotebro (bellite) and Persberg (nitroglycerine). The output amounted to 559,294 kilog. (1,230,000 lbs) dynamite and other explosives, corresponding to a value of $ 193,000.

Matches. Among the chemical industries of Sweden the manufacture of matches certainly occupies the very first rank, and may even be said to be one of the most important export industries of our country. »Swedish matches» have a good name abroad and their labels are extensively imitated. In 1845, J. E. Lundström founded the manufactory in Jönköping, which afterwards obtained a world-wide renown; but it was only after 1852 when Lundström had invented the method of making matches without phosphorus that so-called safety matches were made here. The brother of the inventor just mentioned, C. F. Lundström, who deserves great credit for his efforts on behalf of this industry, had, in 1850, introduced the Swedish matches in the English markets. By degrees match-manufactories were established in other parts of the country, so that in 1860 there were already 14 at work, in 1885 there were 34 and in 1890, 26. The total output during the year last-mentioned was valued at over 2 million dollars.

The rapid development which this trade has had in Sweden is owing to the rational manner in which it has been carried on, as also to the equality of the manufacture, and that machines have now begun to supersede the time-wasting manual labour. The chemicals necessary have hitherto chiefly been imported, mostly from England; at present, however, a manufactory is being built for the preparation of chloride of potash electrolytically. Aspenwood is used both for matches and boxes, which raw material, to a certain degree, must be imported.

The following figures show the export of matches:

Year.	Kilog.	Lbs.
1865	947,600	2,095,000
1875	8,836,900	19,485,000
1885	13,860,400	30,562,000
1890	13,118,000	28,925,000
1891	13,461,000	29,681,000
1892	15,359,000	33,867,000

By far the greater part was exported to Germany and England. In 1890 the value of matches exported to Germany was $ 1,045,000, and to England $ 924,000.

Besides the well-known safety matches, the old phosphorus matches are still made in Sweden, but chiefly for export. For hygiene in match factories, see page 204.

In Sweden there are three works for materials for match-making, with a total output, in 1890, of $ 55,000, and one factory for matchboxes (see page 132).

Paints, Colors, Dyes and Varnishes.

Since Sweden is very rich in minerals and earths containing colored raw materials, it might naturally be imagined that a large manufacture of paint is carried on. Such is, however, not the case, as but a few coloring-materials are prepared on a large scale, among which nevertheless red ochre and lamp-black deserve special mention.

Red ochre is obtained as a by-product when preparing copper by smelting, and has for centuries been produced at Falun Copper Works. By an admixture of green vitriol, a coating matter is obtained which protects timber from decay in a most efficient manner, and is therefore generally used for painting wooden buildings. As a natural sequence the manufacture of red ochre is of great importance and amounts to 1,200 to 1,500 tons a year; an export takes place to Finland.

Lampblack — which was formerly simply soot formed by partially burning birch bark and similar substances — is now produced cheaper by grinding thoroughly charred wood. This production is very extensive so that in 1890 lampblack was exported for $ 45,000.

Chrome-yellow is certainly prepared from raw material, obtained from abroad, but nevertheless is largely exported to Germany. Ochres are found in very large

quantities and of very different shades of color, from black and green to blue and yellow, and at many places the elutriation of colors is undertaken.

The color most generally used is however *chalk* which is obtained and elutriated at several places, especially in Skåne. It is remarkable for extreme purity and whiteness of coloring, and is exported in large quantities, valuing, in 1890, $ 50,000.

Colors forming metallic *salts* of *nickel* and *cobalt*, etc. are prepared in large quantities by the METAL EXTRACTION Co. Lim. in Falun; besides which the salts of the rare metal Vanadium, — discovered in Sweden in 1830, — more especially vanadic ammonia, which is used to a great extent in dyeing black, are prepared by G. E. CASSE.

Fire-proof paint has of late years been manufactured in Sweden, and seems to obtain more and more favor with the public. As a general rule it contains certain ingredients which do not fuse readily and which hinder the access of the air to the heated mass, and thus delay the breaking out of the flames. In consequence of the great number of wooden buildings here, this paint will doubtless be extensively used in times to come.

Varnishes have of late been manufactured though to no very large extent.

In 1890 there were 10 color and varnish works in Sweden with an aggregate output worth $ 134,000. The export of colors and pigments in the same year amounted to $ 106,000, while the import ran to $ 1,071,000.

Paper and pulp industry.

Paper manufacture during the last few years has had in Sweden a particularly extensive development, which is in a great measure due to our great wood-pulp industry. The most commonly produced kinds of paper are correspondence paper, writing paper, printing paper, wall paper and cardboard. The kind of paper mostly exported, is *printing paper* — especially that for news-papers, which paper is generally manufactured of from 50 to 70 per cent ground wood-pulp, and the remainder either of chemical wood-pulp or rags.

Wrapping paper and wall paper is also exported, made either of unbleached, chemical wood-pulp, or of semi-chemical pulp (from boiled wood) or of mixed chemical and ground pulp. Banknote and stamped paper is manufactured at the government paper mill, TUMBA, situated a few miles south of Stockholm. There is also manufactured a filter paper well known abroad; it is made at GRYCKSBO in Dalarne, where there is found suitable water of peculiar purity, desirable in the manufacture of this paper. Of great importance is the manufacture of cardboard, as well for the lining of walls (sheathing) as for roofs. That used for the latter purpose is saturated with bitumen, which is afterwards hardened by the action of the air and thus the paper rendered both fire- and water-proof. In the composition of such pulp, rags of mixed fabrics (wool and cotton) also enter, giv-

ing a certain elasticity and porousness to the cardboard. Both kinds of paper are manufactured at MUNKSJÖ near Jönköping and at FISKEBY.

In 1890 there was in Sweden a total of 38 paper-manufactories; and in the same year the total product value amounted to $ 3 million. The number of wall-paper manufactories was 10, with a product value of $ 273,000.

The import and export of the above articles in 1890 were valued at:

	Import.	Export.
Cardboard	$ 118,000	$ 644,000
Wall paper and borders	55,000	197,000
Cartridge paper	——	395,000
Other kinds	800,000	5,100,000

Wood-pulp is at present one of Sweden's more prominent articles of export and the production of this raw material for paper may be called one of the natural industries of the country, thanks to the rich supply of timber suitable for the purpose and of motive power which is supplied by the numerous waterfalls. As far as concerns the technical development of this industry, Sweden has from the very first taken a leading position, especially as regards the invention and introduction of various improved and simpler methods. Already in 1857 was founded at Trollhättan by a merchant, Mr. Francke, the first wood-pulp factory, which still exists under the name of ÖNAN's Mill. In this establishment Völter's system was used, according to which the pulp is produced by the grinding of unboiled blocks of wood against a sandstone, revolving on a horizontal axle, the blocks being saturated with water during the grinding. More latterly established manufactories for the production of wood-pulp from raw blocks have as a rule the grindstones lying horizontally, while hydraulic pressure is used for bringing the wood in contact with the stone. Another method which afterwards has been introduced at several works (at Emsfors, Önan, Munkedal and others), consists in boiling the wood in water before grinding. By the use of this so-called half chemical wood-pulp, the paper no doubt becomes stronger, but is darker in color, as the pulp after being boiled is difficult to bleach.

In late years has been introduced into Sweden the manufacture of chemical wood-pulp, or, as it is commonly called, *cellulose*, partly by the use of caustic soda, partly by sulphite of lime according to Mitscherlich's method, and partly by sulphite of magnesia, the last being the method of a Swedish engineer C. D. EKMAN. Still another method has been lately introduced, namely the use of a lye which for the greater part consists of sulphate of soda, and which method is cheaper than any of those before mentioned.

The Swedish wood-pulp factories increased rapidly until 1870, after which time (1872) there came a period of stagnation which lasted till 1880, when their number again rapidly rose. About 1870 many factories stopped their production, to a great extent on the ground that in England, which is Sweden's chief customer for wood-pulp, there commenced to spread a certain mistrust against the utility

of this raw material. It was supplanted gradually by Esparto grass, which soon again was displaced by wood-pulp. In 1875 there were in Sweden 18 wood-pulp manufactories with a product worth of $ 300,000; in 1885 the factories had increased in number to 38, with a product value of $ 917,000, while Sweden in 1890 had 117 such factories, of which not less than 33 were founded in 1889, besides which many of the older manufactories developed considerably during late years (e. g. Munksjö, Trollhättan, Vargön etc.). In the same year, 1890, the production of ground wood-pulp amounted to 101½ million kilog. (223 million lbs), of soda cellulose 23½ million kilog. (about 52 million lbs), and of sulphite cellulose 24 million kilog. (53 million lbs) or a total of 149 million kilog. (328 million lbs) of dry wood-pulp.

In Sweden, chiefly spruce, but also fir and aspen, is used in the manufacture of wood-pulp. Scandinavian wood-pulp has a decided advantage over, for example, the German, since in Germany pine is used, which is richer in resinous matters resulting in a more rapid darkening of the paper. Especially as far as concerns the quality of chemical wood-pulp, Sweden undeniably takes the first place. If it must be admitted that the chemical method for the production of wood-pulp gives a better, longer fibred pulp, on the other hand it cannot be denied that this pulp is dearer, especially when made by the 'soda' method, since soda has risen considerably in price.

Sweden's chief customers for wood-pulp are England, Germany, North America, Finland and Norway. This export has been in constant and steady growth, as the following figures show:

Year.	Kilog.	Lbs.
1872	5,786,000	12,758,000
1877	6,148,000	13,556,000
1882	9,249,000	20,394,000
1885	15,822,000	34,888,000
1886	25,152,000	55,460,000
1890	64,396,000	141,993,000
1891	86,346,000	190,393,000

The price has during this time fallen over 50 %, in consequence of which the value of the exported pulp only increased from $ 365,000, in 1872, to $ 2,412,000, in 1891.

As far as concerns the other important raw material, **Rags**, the export is comparatively insignificant, amounting in the year 1890 to the value of $ 18,000, while the import in the same year had a value of $ 59,000.

Amongst the objects manufactured of paper or of cardboard are especially to be noted *labels, envelopes, paper-bags* and cardboard-boxes, all of which are made on a large scale at the Norrköping Lithographic Company's Works, and which are also exported. Thus in 1890 labels were exported to the value of $ 33.000. *Playing Cards* are also manufactured in Sweden, being made under State control,

so that every packet must be stamped before sale. Even to play with unstamped cards is in Sweden forbidden under penalty of a fine. Swedish playing cards are considered very good. In 1890 there were exported 6,834 packs of playing cards. In the same year labels were imported to the value of $ 61,000, envelopes and paper-bags to a value of $ 57,000, portfolios to $ 95,000 and various other cardboard goods to a value of $ 136,000.

Furniture of interiors, Upholstery and artistic decoration.

Cabinet-making has very much developed in Sweden during late years. This fact is partly owing to the circumstance that an ample supply of suitable raw material is to be found in the country, and also that the national technical schools and especially the Technical School in Stockholm, have tried to spread artistic and tasteful designs amongst the workmen. The cabinet-making industry of Sweden can therefore well compare with the best work of other countries. Towards the development of this taste for suitable designs and the promotion of technical skill the Swedish Sloyd Association has also laboured for a long time and does so still with great success, partly by means of publications, partly by the awarding of premiums.

A branch of this industry, which in late years has obtained especial notice for solidity and artistic taste, is *oak furniture*, especially for the dining room. Scandinavian oak gives a hard, durable and handsome material, surpassing by far that from southern countries and well suited for carving; and the buffets, cupboards, dining tables and chairs of oak which are nowadays made, are productions sought after even in foreign countries. For panelling and parquet floors this kind of wood is also employed to a very large extent. The works made of oak are commonly wax-polished, so that the markings of the wood may appear plainly through the usual dark lustre of the polish.

Amongst other Swedish kinds of wood are also used elm, alder, maple, birch and pine, either solid (in which case the wood is either polished or stained) or veneered, as is commonly the case with furniture of pine and birch.

Veneered goods are manufactured to a great extent, especially in walnut and mahogany veneers. These veneers are usually imported in a prepared state. In 1890 the value of such imports amounted to $ 83,000.

In late years the use of iron bedsteads has come more and more into fashion, and these goods are manufactured in many places in this country; both simple, folding beds and the large, so-called 'imperial' bedsteads of specially artistic make being produced. Chairs, made exclusively of stout iron wire, are also manufactured; they are either painted or receive a metallic coating of nickel or of gilding.

Also to be noted are the so called »ladder-backed» chairs, usually of varnished birch and manufactured at JÖNKÖPING and its immediate neighbourhood in Småland, where the furniture industry is of peculiarly great dimensions. At

KATRINEHOLM also there is a large furniture manufactory, where cheap, but at the same time, tasteful furniture of birch and pine is manufactured on a large scale.

In 1890 there were in Sweden 17 furniture manufactories (of which 12 were in the province of Jönköping) with a total product value of $ 136,000. In the same year were exported upholstered goods to the amount of $ 3,200 and similar goods were imported to the value of $ 31,400, inclusive of some un-upholstered furniture. Compare page 178.

Ceramics and Mosaics.

Pottery and Porcelain etc. of all kinds are manufactured in Sweden, as an ample supply of good clay is to be found. The best beds of clay are situated in the neighbourhood of Upsala, which clay is better suited for coarser kinds of faience or majolica, stove-tiles etc., and at Höganäs in Skåne, which clay occurs as a stratum in a coalbed and is very fire-proo .

Swedish *bricks* are exported chiefly to Denmark and to the Baltic provinces of Germany and Russia. In 1890 different kinds of bricks were exported to a value of $ 308,000. The brick factories amounted in the same year to the number of 292, employing 5,509 workmen and with a product value of $ 1,340,000. Swedish building bricks have as a rule a red color in consequence of the ferruginous quality of the clay. At HÖGANÄS in Skåne, there are manufactured amongst many other kinds of clay goods, such as pipes, tiles etc., also fire-proof bricks of first rate quality (see page 111).

There are two *porcelain* manufactories in Sweden, namely RÖRSTRAND, founded 1726, and GUSTAFSBERG, established 1827. Both of these manufactories carry on an important trade, making all kinds of porcelain, from the coarsest delf (faience) to the finest and most artistically decorated objects of feldspar porcelain. In the year 1758 was founded another faience and porcelain factory, namely that of Marieberg, near Stockholm, but which was closed after 30 years activity. Old Marieberg porcelain is nowadays much sought after by collectors and brings very high prices. Rörstrand has gained renown for its *majolica*, in the same manner as Gustafsberg for its *parian* porcelain. The raw material is brought to a great part from England (blue clayf rom Devonshire and white from Cornwall), but native clay also enters largely into the raw material of the porcelain, partly as a binding material and partly as an unplastic ingredient. Flint is brought either from Denmark (Möen) or from France (the neighbourhood of Dieppe), while the fire-proof clay is obtained from Höganäs in Skåne, or from England. The greatest part of the manufactured porcelain is used by the country itself, while there is bnt an inconsiderable export to the neighbouring countries of Norway, Denmark, Finland and Russia. In 1890 the product value at Rörstrand amounted to $ 472,000 and at Gustafsberg to $ 322,000. In the same year white pottery (faience) was exported to the value of $ 59,000, decorated porcelain to the value of $ 64,000 and hard porcelain or china to the amount of $ 21,000.

In both of these factories, as well as in several other places are manufactured *tiles* («kakel») for the stoves so much in use for the warming of dwelling rooms; and since this system of heating is almost universal in Sweden, the stove tile-manufacture is carried on to a very large extent. So fine has become the decorative arrangement of these stoves, which are made usually of faience or coarse majolica with white or colored glaze, that there is a growing demand for them even abroad.

In 1890 there were in Sweden 61 manufactories for the production of stove tiles and earthenware, and the product value in the same year amounted to $ 433,000, while the exported value of such tiles was $ 1,500. In the same year genuine and imitation porcelains (china and pottery) were imported to the value of $ 211,000 and bricks of different kinds to the value of $ 93,000.

Stone, porphyry, marble etc.

Swedish granite is worked to a great extent for tomb-stones, columns and every kind of architectural decoration. The fine-grained, steel-grey granite from the neighbourhood of Stockholm is much used on account of its beautiful appearance and its durability. Red and black varieties are also found and used for monuments and decorative art. The largest stone quarries and factories are situated in Bohuslän, Blekinge, Småland and the neighbourhood of Stockholm. Objects worked from granite are still very expensive, since modern, time saving machinery — especially for grinding and polishing — has not yet been introduced. For the manufacture of decorative objects in general, *porphyry* is used, which is found in great abundance in the parish of Elfdalen in Dalarne. This stone is particularly hard and can therefore receive a beautiful polish. It is found in all shades of color, which depends on the coloring of the feldspar ingredient of the stone. As early as 1785 a company was formed for the utilization of this porphyry and in 1788 the work started. These porphyry works were afterwards purchased by the then Crown Prince, and afterwards King Charles XIV Johan, but came again into private hands. Many fine pieces of work testify the excellent qualities of this stone, for example the pedestal belonging to the statue of Gustavus III in Stockholm, the celebrated porphyry vase at the summer palace of Rosendal in Stockholm and the sarcophagus of Charles XIV Johan in the Riddarholm church. All these monuments are of considerable dimensions, the porphyry vase, for example, being 4·5 metres (14 3/4 feet) in diameter and 2·7 metres (8 3/4 feet) in height, and weighing 6,590 kilog. (14,530 lbs). Nevertheless, the remoteness of the situation and bad means of communication at the quarries prevent the working of this fine material on a larger scale. At Orsa in Dalarne many articles of decoration and luxury are at present manufactured from porphyry, such as urns, vases, table-tops etc.

Marble, especially the green veined variety from Kolmården and the grey-

ish from Gotland, has for many years past been worked for grave monuments, table-tops, urns, etc. Kolmård marble consists of crystalline limestone containing serpentine, which gives a spottish green appearance to the stone. Several parts of the New Opera House in Paris are of Kolmård marble. See page 106.

The export of polished, worked stone amounted in 1890 to only S 465 in value, whereas other stone was exported in 1891 to a value of nearly S 1,070,000.

Glass and glassware.

The manufacture of Glass in Sweden originates from the middle of the 17th century. The oldest glass factories are KOSTA in Småland, established 1741, LIMMARED in Vestergötland, founded 1740, and REIJMYRE in Östergötland, dating from 1809. These factories are considered to be still the largest. In 1890 there were 36 glass works in operation, of which the greatest number, or 21, are situated in Småland. They employed that year 2,904 working-people, of whom 175 were women. Of the raw materials, the quartz is usually taken from the neighbourhood of the factory, the sand is generally brought from the shores of Lake Vettern, while the lime is obtained from the mining district of Nora, from Skåne or Gotland.

The glass industry has of late years gone steadily forward, though the manufacture is still confined to that of the simpler descriptions, as bottle glass, common window glass etc., while the finer qualities (mirror glass, etc.) are not manufactured in the country. The total product value in 1890 amounted to S 969,000, of which picture-, frame- and window-glass came to S 214,000. The exports of pans, pots and other kinds of glass vessels amounted in the same year to S 266,000, and to about S 179,000 of other kinds (window glass etc.). During the same period the imported glassware had a value of S 473,000, of which window glass and mirror glass amounted to S 110,000.

During late years *painting on glass* has been introduced as well on window glass as on fancy glassware. Etched and cut-glass objects are also produced, but chiefly as a handicraft.

Horology.

The **Watch** and **Clock** industry does not take any specially prominent position in Sweden. Watches are imported chiefly from Switzerland, Germany and France. On the other hand, wall-clocks, tower-clocks, station-clocks, etc. are more and more manufactured in the country and even exported to the neighbouring countries.

The population in many provinces, especially in Dalarne, display great mechanical skill, and for a long time Dalecarlian clocks have been much used in the country, principally those from the district of Mora, manufactured as a home-

industry. But as these clocks cannot well compete with the systematically manufactured clocks either in cheapness or in artistic taste, this home-industry is beginning gradually to disappear.

In 1890 there were in Sweden 29 time-piece factories with a product value of $ 25,000. The chiefest among these is HALDA watch factory, which produces yearly about 6,000 watches both of gold and silver. In the same year watches were imported to a total value of $ 476,000, and other time pieces, as wall clocks, table clocks, etc. to a value of $ 351,000.

Silk and Silk fabrics.

Already in the middle of the last century efforts were made to introduce *silk-culture* in Sweden and in the year 1750 there were about 100,000 white mulberry trees in Lund. Silk was produced and the Government favored the enterprise with subsidies and premiums, hoping thereby to develop a national industry. In consequence of the unfavorable climate, silk-culture began to decay, until in 1830 was formed a »Society for home silk-culture», in which society among other members were Berzelius and Sven Nilsson, and of which Queen Josephine afterwards became patroness. This society, which still exists, had in 1875 a return of about 12 kilog. of raw silk, which was sold for $ 190. In 1876 the government subsidy ($ 1,000) was withdrawn, in consequence whereof there now exists but one silk-growing etablishment viz. at BORGHOLM in Öland, where the present annual production is from 2 kilog. to 2 ½ kilog. According to skilled opinions, cultivation of the silk worm could be very profitably carried on in Sweden, especially in Skåne, where the climate is favorable to this pursuit.

The reason for the small interest, taken in silk-culture, is probably to be found partly in the fact that the soil can be used with equal profit for the cultivation of root-crops, and partly in the difficulty found in preventing the premature hatching of the eggs in the spring before there are any leaves. Of a certain interest are the efforts lately made with considerable success to breed the *oak-silk-worm* (Bombyx—Yama—Maï).

As early as 1673 there was an establishment in Stockholm, for *silkweaving*. During the long wars of Charles XII this industry as well as many others were destroyed, but commenced to flourish again in 1760, thanks to the prevailing protection- and premium-system of the Government, so that the workmen employed in silk-weaving amounted to 2,000. In the year 1845 there were 18 silk-weaving factories with 600 weavers and a produce-value of $ 275,000. At present there are but two such weaveries in Sweden, both in STOCKHOLM, where the work is now restricted to the weaving of head and neck clothes, which are still much used by the rural population, and of ribbands for orders, fancy articles, etc. Silkfabrics are nevertheless exported, these exports in 1890 amounting in value to $ 50,000 for pure silk goods and to $ 10,000 for cotton-silk articles, while the total manu-

factured value amounted to $ 142,000. The import of pure silk goods came to a value of $ 880,000 and of cotton-silk to $ 558,000.

Yarn and Fabrics of Cotton, Linen and other vegetable fibres.

Cotton *spinning* holds a very prominent position amongst Swedish textile industries. The largest cotton factories are found in Norrköping, the »Manchester of Sweden». Especially may be mentioned the firms of Holmen and Berg in Norrköping, Rosenlund in Göteborg, Jonsered and Nääs in the province of Elfsborg, Rydboholm in the neigbourhood of Borås, and Barnängen at Stockholm. In 1890 there were in Sweden 24 cotton factories, numbering about 245,000 spindles, with a product value of $ 3,500,000 and employing about 4,600 workpeople. The export in 1885 amounted to $ 127,000, principally to Norway and Denmark, which had increased in 1890 to a value of $ 89,000 for undyed, single cotton yarn, $ 79,000 for undyed, double yarn, and $ 26,000 for dyed cotton yarn, or a total of $ 194,000. In the same year cotton yarn was imported to the value of $ 931,000.

In 1890 there were in Sweden 26 cotton *weaving mills* with 3,739 weavers. In these were produced cotton cloth, calico, shirting, fustian, moleskin, etc., to a total value of over $ 3,618,000, and a manufactured length of about 40 mill. metres. In the town of Borås there are 5 such mills and in Norrköping 3, amongst which latter is to be found the largest in Sweden and which alone manufactures $^1/_5$ of the total cotton-cloth production of the country. The weaving and spinning mills of Norrköping derive their motive power principally from a stream flowing through the town and abundant in waterfalls, the clear water of which is of an especial value in textile industries, as steeping and washing processes often occur in the manipulation of raw material as well as in that of the manufactured fabric. The export of cotton fabrics has considerably increased during late years, as the following figures show:

	1885.	1890.
Unbleached and undyed	$ 181,000	$ 290,000
Bleached or colored	206,000	564,000
Printed or stamped	147,000	62,000
Total	$ 534,000	$ 916,000

In 1890 cotton goods of different kinds (carpets, tulle, cotton-cloth etc.) were imported to a total value of $ 3,052,000, which shows that the country's own production is far from sufficient to satisfy its requirements.

In the town of Borås is carried on a considerable weaving industry which has spread among the rural population in the surrounding districts. In almost every home, however poor it may be, is found a hand weaving machine at which the inmates almost continually work, and this home-sloyd has reached such pro-

portions that it may be considered as an industry. Certain capitalists advance money for the purchase of cotton yarn, which is then woven after certain fixed designs. In this manner from 2,000 to 3,000 women weavers work in their own homes for a single capitalist. Both Jacquard and fancy weaving is produced in this fashion and not only of cotton but also of linen and wool. That this *home-industry* is not inconsiderable, is shown amongst other things by the fact, that in 1890 there were woven in this manner about 15 mill. metres (50 mill. feet). If these figures are compared with the total mill-production, 40 mill. metres, it will plainly be found what an important place this home-sloyd holds.

Flax, as well as **hemp**, is cultivated in Sweden for textile purposes, th former to a very great extent and of especially good quality. The export of these textiles is still inconsiderable, amounting in 1890 to but $ 300 for dressed (haekled) flax and to $ 400 for undressed hemp. In 1890 there were in Sweden 3 flax-spinning mills, — ALMEDAL, JONSERED and HALMIA — with a total produce-value of $ 318,000 and a total produce of 806,500 kilog. (1,780,000 lbs.). But one linen-weaving mill was then in operation (Almedal) with a produce-value of $ 90,000. The export of linen goods in the same year amounted to a value of $ 30,000 and the imports to $ 247,000. Compare page 55.

Sail and **Tent canvas** are woven at the above three factories, the produce-value amounting in 1890 to $ 268,000. The most important is the mill at Jonsered. In 1890 sail canvas was exported to a value of $ 16,000.

Jute-cloth mills were, in 1890, three in number with a produce-value of $ 295,000. Jute-cloth was in the same year exported to a value of $ 25,000 and imported to the amount of $ 250,000.

Spinning and weaving are in Sweden very considerable *home industries*, especially of the raw materials flax, hemp and wool. The long, dark winter evenings, when the women amongst the country folk must busy themselves with work indoors, are well suited for such employment, and an additional inducement is the fact that the flax cultivated in this country is of superior quality. Unfortunately this home industry is beginning very much to languish in consequence of the competition of the manufactured and cheaper goods. In northern Sweden, especially in the coast provinces Vesternorrland and Gefleborg, is cultivated a particularly longfibred and strong flax of which the people for generations have spun an extraordinarily fine yarn. For very fine linen spun and woven in these provinces, the Government pays a premium, and the highest premiums are paid for such woven cloth that has a breadth of 0·891 metre (2¼ feet) and from 4,120 to 4,320 warp-threads. What especially contributes to give strength and whiteness to these handwoven flax fabrics is the circumstance that the maceration of the flax as well as the bleaching of the linen is done in the fields in the open air, which certainly lengthens the process, but on the other side has the result that the fibre is not destroyed by the more powerful chemical methods which

are used in mill factories. This »dew-steeping» of flax on the field is used over the whole country, lasting for a period of from 6 to 10 weeks, after which follow breaking, cleaning and hackling, entirely by hand.] The spinning is performed on the spinning wheels, having one or two spindles.

Woollen Stuffs.

The Woollen Industry in Sweden was founded in the beginning of last century by Jonas Alströmer, who endeavoured to carry on this manufacture solely by native raw materials. For this purpose he made an attempt to naturalize foreign sheep and goats, especially from England, Spain and Asia Minor. The attempt was at the beginning crowned with success, but nevertheless several of the imported long haired breeds, as the Angora and Alpaca goat, have now become entirely extinct. The wool industry was concentrated at first in Alströmer's native town Alingsås. This town speedily became an important industrial centre, but did not continue so long. At the present day the wool produced in the country is far from sufficient and must be supplemented by large yearly imports. Thus in 1890 dyed and undyed wool was imported to the amount of $ 2,000,000, while the exports reached but $ 31,000 in value. The wool is usually imported from the Cape, Buenos Ayres, Australia and Germany (Silesia).

Woollen **Cloth manufacture** has its chief seat at Norrköping, where there is an ample supply of water, necessary as well for motive power as for certain processes recurring in the manufacture. This town has for more than two centuries been an important manufacturing town, and already in the time of Charles XI it was able to clothe the whole Swedish army with cloth of its own manufacture. In the interval this industry has passed through many difficulties until the present day, when it has taken an especially prominent position. The town of Norrköping produces about two-thirds of all the wool cloth manufactured in the country. The cloth mills amounted in 1890 to 48 in number with 4,788 workpeople and a produce-value of $ 3,655,000. In the same year there were 25 mills for other woollen fabrics, worsted goods and cotton warp cloth, with a produce-value of $ 1,331,000, and 14 *Stocking-weaving* mills for the manufacture of stockings, jerseys, drawers, neckclothes, etc., with a produce-value of $ 545,000. The chief cloth mills are Drag, Bergsbro and Ström in Norrköping and Wallberg's in Halmstad (Slottsmöllan).

The manufactured woollen cloth supply is far from sufficient for the needs of the country, so that a great amount is yearly imported from abroad. For example in 1890 different kinds of woollen fabrics, chiefly clothings, were imported to the value of $ 6,720,000, stocking goods to the value of $ 622,000, and woollen yarn, dyed and undyed, to the value of $ 1,480,000. In the same year were exported machine woven felts to a value of $ 9,700, carpets to a value of $ 2,700, stocking goods worth $ 76,000 and other kinds of woollen goods to the amount of $ 600,000.

Although, as is seen above, a great deal of woollen yarn is yearly imported, there are yet in Sweden not less than 98 woollen-yarn spinning mills with a total produce value of $ 1,354,000.

Clothing, Fur-Goods, Laces, etc.

The manufacture of ready-made **Clothing** or in general of such goods as belong to clothing is carried on in Sweden principally as a handicraft, although there are to be found several manufacturing establishments for such goods. In 1890 there were in Sweden 3,055 tailors and 4,063 shoemakers. The supply is still far from sufficient for the wants of the country, which is evident from the fact that in the same year new wearing apparel was imported to the value of $ 1,822,000, shoes of leather to the value of $ 397,000 and of silk, felt or canvas to the amount of $ 218,000, while the exports reached but $ 58,000 for wearing apparel and $ 96,000 for leather shoes. The number of factories engaged in shoe-manufacture is but 4, with a total produce-value of $ 250,000. The country people in certain districts wear shoes made entirely of wood, — commonly alder wood, every shoe cut in one piece. Two such *Wooden Shoe* factories exist with a produce-value of $ 52,000.

Amongst other articles of clothing, which to some noticeable extent are manufactured in Sweden, are to be noted *hats* and *gloves*. In 1890 there were 7 hat manufactories with a produce-value of $ 284,000 and employing 479 hands. The raw material is usually wool, but hair is also used (from the rabbit, hare, beaver and bisam). The exports amounted to a value of $ 80,000, while hats were imported to the amount of $ 293,000.

In the manufacture of gloves Sweden has obtained a certain reputation abroad in consequence of the introduction into the market of gloves, in which the leather is placed with the hair-side in and the flesh-side out, contrary to the ordinary custom. These gloves, fashionably known as »Gants de Suède», are manufactured solely in Skåne, where there are 9 such factories, with a produce-value of $ 140,000. The exports of such gloves amounted in 1890 to a value of $ 11,000.

The manufacture of wearing apparel and such like articles is done to a great extent in the home, thanks to the great extension in the use of the sewing machine.

The **Fur-Goods** Manufacture in Sweden is inconsiderable. Only one establishment for the manufacture of fur-goods exists, with a produce-value of $ 44,000. The export of various fur-goods, prepared and unprepared, amounted in 1890 to $ 102,000, and the imports to $ 414,000.

Laces, Braids, Embroideries, Artificial Flowers, etc., are manufactured on a small scale, and of them there is a very inconsiderable export. The imports of lace amounted in 1890 to $ 206,000, of braid to $ 211,000 and of artificial flowers to $ 141,000, thus amounting to a considerable sum. At the town of

Vadstena, where during the middle ages existed a nunnery, is still at the present time among the inhabitants found a very great skill in *lace-making*. This kind of work was practised with great talent by the nuns in that celebrated convent, which was founded by St. Brigitta during the 14th century. Although queen Louise, the wife of Charles XV, by several means tried to support and encourage this home-sloyd, still it was found difficult to develop it to any higher degree, probably on account of the want of a methodical system.

Toys and fancy articles.

The Manufacture of *Toys* has in Sweden of late years risen to a very considerable importance. In 1890 there were 4 toy factories with a produce-value of $ 18,000. In 1892 the number of factories had increased to 7. Swedish toys, which are usually made of wood and are marked by durability and appropriate forms, have won prizes at many exhibitions and are today exported especially to Norway and Denmark. This export amounted in 1890 to $ 1,400. The imports have in the same period very considerably diminished and decreased from $ 134,000 in 1883 to $ 43,000 in 1890.

The principal toy-factory in Sweden is Gemla, founded in 1866 and situated near the town of Vexjö. Here are manufactured not only toys for children, but also a great amount of useful and at the same time amusing objects for the little ones and many materials for school-instruction. Thus are manufactured ordinary toys, doll's-furniture, etc., besides all kinds of games such as parlor-games of skill, croquet and nine-pins, counting apparatus, and stereometrical figures with sections etc. To all appearances, this industry will in the future be more and more developed.

Scales and Measures.

The manufacture of **Scales** holds a prominent position in Sweden and increases the more, partly because most merchandise is now-a-days sold by weight, and partly because, since the introduction of the metric system, scales can be manufactured also for export. All kinds of scales are made, — such as *Shop-scales* both for wholesale and retail trade, *Manufacturing-scales*, *Crane-scales*, *Transport-scales*, etc. As far as concerns the different systems of weighing, those commonly used are the balance scale, the decimal and centesimal scales, and in later times are introduced scales with sliding weights.

Amongst the 8 Swedish factories existing in 1890 for scale manufacture, Tengelin's Scale-factory in Stockholm takes the first place. This establishment which was founded in 1823, manufactures a speciality namely the so called *steel-yards* according to their own patent, and especially suitable for market business. Scales are now-a-days exported especially to Denmark and Finland.

Material of war.

Guns, etc. In 1860 was introduced into the Swedish army a rifle invented by Mr WREDE, a Swede, and this rifle was in its time considered to be the best in Europe as far as the ballistic qualities were concerned. The rifle-pattern adopted after 1867 was the Remington. All rifles for military use are manufactured at the factory of KARL GUSTAF'S TOWN, Eskilstuna, under Government control. Besides these, other rifles are manufactured at HUSQVARNA, especially for sporting purposes. The rifle factories are generally using rolled barrel-material of Bessemer steel from the Fagersta iron works. In late years the customary hardening of the barrels has been abandoned as being troublesome and inconvenient, the hardening being obtained through cold-hammering of the barrel. The produce-value of the rifle factory at Eskilstuna amounted in 1890 to $ 47,000. In the same year sporting rifles were imported to the value of $ 20,000, and exported to the amount of $ 8,000.

As early as 1587 the FINSPONG *gunfoundry* obtained its first charter for casting cannons, and this foundry still continues to be the foremost in the industry. With Finspong nowadays competes BOFORS-GULLSPÅNG. Both factories produce heavy guns from Martin steel, which is cast to a block, afterwards hammered, bored, turned and hardened. King Gustavus II Adolphus can be said to have reformed the gun-manufacture of his time, as he changed the then used metal cannons for short cast iron guns, and introduced the *cartridge* which was an important improvement. The first breech loading gun is generally supposed to have been constructed by WAHRENDORFF, a Swede, in 1840.

The so called »Swedish mitrailleuse» was invented in 1872 by the Swedish engineer PALMCRANTZ and has generally, where it has been subjected to experiments, been considered as the best of its kind. It has all the barrels (commonly 10 in number) lying parallel with each other in the same horizontal plane. This weapon is best known abroad under the name of »*Nordenfelt Guns*», after the name of Mr Th. Nordenfelt who introduced many improvements. These guns are manufactured both in London and in Sweden at KARLSVIK'S factory of arms, situated in Stockholm. They have been introduced into the naval and military services of many European countries.

Projectiles of different kinds are manufactured at Finspong, Bofors, Åker, Hellefors and Ankarsrum. Small shot is made at the mines of Falun and Sala. Cartridges etc. for smaller as well as for larger weapons are made at Marieberg at Stockholm by a division of the fortification-corps.

Lighting apparatus and appliances.

The manufacture of **Stearine Candles** takes in Sweden a very prominent place. Swedish stearine candles are considered superior to the foreign artiele in

quality and illuminative power, in consequence of which they have, although dearer, displaced the foreign manufacture in the home market. The factories are but two in number, viz. at LILJEHOLMEN near Stockholm and at ALVIK in the province of Stockholm, the total produce-value amounting in 1890 to S 374,000. In the same year candles of different kinds were imported to the value of S 34,000 and exported to the value of S 52,000. In 1890, stearine was imported to the amount of S 53,000.

The *tallow candles,* used before the introduction of stearine, are found now only in the rural districts, where they are a home-produce.

The illuminating material most generally used in private dwellings is *Mineral-Oil,* which may be partly »fotogen» or rectified petroleum, partly benzine or as it is called in Sweden, gas-oil. In consequence of its freedom from smell and lesser liability to ignite the former oil is most used; still gas-oil is very much burned especially in the country, and for such purpose is used a lamp invented by Prof. WILANDER, which lamp ensures great security against ignition and explosion. In 1890 unrefined paraffin to the amount of S 105,000 was imported, — together with raw mineral-oil worth S 114,000 and rectified oil, fotogen etc. to the worth of S 1,726,000. That the consumption of paraffin in Sweden has increased on a very great scale during the past few years is proved by the large increase in the imports of this illuminative. These imports amounted

In 1875 to 9 mill. kilogram.
» 1886 » 26 » »
» 1889 » 43 » »

The greater part is imported from North America.

The increased use of mineral-oil for lighting purposes has resulted in a very important development of the **Lamp-industry.** There were in Sweden in 1890 five lamp-factories with a produce-value of S 61,000. Especially well known is W. WIKLUND'S factory in Stockholm for beautiful chandeliers, hanging and table-lamps, candlesticks etc. manufactured of various alloys.

Illumination by means of **gas** was introduced in 1847 at Gothenburg, in 1852 at Norrköping, in 1853 at Stockholm and in 1854 at Malmö. In 1876 twenty five Swedish cities had adopted this system of lighting. The fuel used at the gas-works is English coal, although wood is also used successfully in many places. Sweden had, in 1890, 27 gasworks whose produce-value amounted to S 608,000. The use of gas has latterly greatly increased, owing to its adoption for house warming purposes by means of gas-stoves, and for domestic-culinary uses by means of gas cooking-ranges. By way of comparison, it may be mentioned that the consumption of lighting gas amounted in Stockholm in 1890 to 47 cub.-met. per head of the population, in Hamburg to 60, in Paris to 100 and in London to 150.

Several attempts have been made in Sweden to introduce lighting by means of *Water-gas,* that is to say, a mixture of hydrogen with Carbonic oxide in the

flame of which is placed an incandescent material. Mr O. Fahnehjelm has the merit of bringing this system into practical use. By means of the high temperature developed, fine needles, or rather filaments of magnesium or lime are rendered incandescent. The attempt has not yet led to any noteworthy result, although in many respects it may be said to have been very satisfactory. Latterly the invention of Auer v. Welsbach, consisting in the use of an incandescent body in a common gas flame, has been introduced and widely spread.

Of late *Electrical Illumination* has begun to be employed, as well for public places as for private homes (see page 182.)

Heating and cooking apparatus and appliances.

Apparatus and Methods for Warming and heating are the objects of an important manufacture in Sweden, a natural consequence of the lengthy winters and the severe climate. Nearly all the different systems of warming are used which are common abroad. Thus the heated air system is employed, though latterly it perhaps begins to be displaced by *steam* and *water* heating apparatus, especially the latter, which seems to give the most uniform and pleasant heat in consequence of the comparatively low temperature of the water. Warming apparatus with steam is used for high as well as for low pressure.

In addition to these different methods of »Central Warming», in private dwelling rooms are used other warming apparatus. Such are *tile-stoves* made entirely of tiles or majolica and usually intended for the combustion of wood; also the iron stoves (Kamin), usually made wholly of iron and intended for heating by steam, warm water, or the direct combustion of wood, coal, coke or gas. Also are manufactured Kamin-Tile-Stoves, or a combination of the two above named kinds, and which consist internally of an iron cylinder which is heated by one or other method of combustion, — and an outer facing of tile to absorb and afterwards slowly distribute the heat. These latter stoves are much in favor, giving an equable and moderated warmth; they have been introduced into many public institutions, such as hospitals, schools, hotels etc., and even appear to be in request abroad.

Amongst other warming apparatus are specially to be noted *iron cooking stoves* for domestic purposes, which are manufactured on a very large scale; further, smaller stoves, or so called »illumination-stoves» chiefly after American models, and moveable stoves or »warming-housewives» after French models. Latterly stoves and cooking ranges heated by *gas* and *petroleum* begin to be employed, and probably will shortly obtain a great sale. The usually employed stoves and cooking ranges in Sweden are constructed with a view to minimum consumption of fuel, the least risk of fire, and fine outward appearance, and may in these respects be placed very high.

In Sweden there are no special factories for the making of the above men-

tioned warming apparatus, but most of the engineering workshops engage in their manufacture. Among the more important may be named J. & C. G. Bolinder's Machine Manufacturing Co. at Stockholm, the Husqvarna and Ebbe works at Jönköping, Ankarsrum factory, Kockum's factory in Malmö, etc. Amongst the more distinguished constructors of Swedish warming apparatus may be named Mr E. A. Wiman, who has patented in most countries his »moderator-stoves» for the consumption of different kinds of fuel and which are known and used abroad. In 1890, cooking ranges and stoves were imported to the value of S 9,200, while their export-value reached S 11,000.

Hardware, Edge Tools, Cutlery, etc.

The manufacture of finer **Cutlery** has in Sweden been concentrated in the small town of *Eskilstuna*, at the lake of Hjelmaren in Södermanland. This town, which fifteen years ago had but 7,000 inhabitants and to day numbers, with suburbs, 15,000, is called, not without reason, the »Sheffield of Sweden» on account of the high degree of skill and perfection, which exists there in the production of finer iron and steel goods. The reputation of Eskilstuna cutlery has spread through the whole industrial world, and its knives, scissors and other edge tools have always successfully competed with foreign goods. An especially important industry is the manufacture of *table-knives,* which were formerly imported from England and Germany, but which today are exported.

The raw material which is generally used for this cutlery consists of Bessemer steel and to smaller degree of crucible cast-steel (Uchatius-steel). In consequence of the purity of Swedish iron the Bessemer steel can be used in the bar iron form, in which it left the iron works. The English method is consequently not used here in producing the raw-material for the finer steel goods, — namely by first changing the welded iron (generally walloon-iron) into cement steel and afterwards homogenizing it by smelting. Latterly the method has been employed in the manufacture of knives that a comparatively soft iron with slight percentage of carbon is used in the production of the various parts, which afterwards by heating in carbonic matters become hardened on the surface. By this so called *Case hardening proeess,* the objects become particularly hard on the surface, and are thus suited for etching or the reception of a high polish, while they retain a certain tenacity, which is wanting in hardened steel.

In Eskilstuna there are no fewer than 128 cutlery factories, being private establishments as well as companies. Amongst the more widely known manufacturers may especially be mentioned the Eskilstuna Iron Manufacturing Company (Tunafors), which chiefly produces table-knives, forks and scissors. Further to be noted are Heljestrand's razors, Hellström's and Dahlgren's knives and scissors, Öberg's and Bergman's files and rasps, Hedengran's etched steel goods, Holmberg's fittings for stoves and doors, and Liberg's skates, — all these objects

showing excellent work, each in its kind. In 1890 knives were exported to a value of $ 4,000.

The different processes for the production of the various articles are in general of the same description. The first process occurs in the smith shop, where the object is shaped in moulds or swages by means of a drop hammer, after which follows the cutting off of the superfluous metal by pressing in one operation, afterwards hardening and tempering of the steel-objects, followed by grinding, which is usually done on a wet sandstone, that the hardening may not be lost through heating. Thus it will be seen that the Eskilstuna manufacture is founded on two operations, forging in swages and *grinding*. An extreme division of labour introduced during late years in every factory, however small it may be, has resulted in the cost of production having been much lowered.

Swedish *Files* are generally more carefully made than the foreign article and are consequently paid for by a somewhat higher price. They are usually cut by hand, but latterly, file-cutting machine have been introduced, though generally with a less satisfactory result. In Sweden there were in 1890 nine file-factories with a product value of $ 46,000.

Spiral drills, Planing irons, Chisels and other edge tools are also made and have won a just reputation in the market. The finest kind of steel articles, such as steel-pens, sewing and knitting needles etc., are not made in Sweden, at least not to any noteworthy extent, as this manufacture requires the use of expensive and special machinery, whereto is to be added the small market and the extreme cheapness of these goods. Still, at present there are in Sweden 2 needle factories with a yearly produce-value of $ 45,000. In the year 1890 needles of various kinds were exported to the value of $ 670, while the imports amounted to $ 40,000.

Another kind of steel goods, manufactured to a great amount and which enjoys a great demand in consequence of the vast proportions of the timber industry, are *saw-blades*. Both frame saws and circular saws are manufactured at many places, of which Trollhättan and the little town of Torshälla are especially to be noted.

Among other edge tools, which are manufactured in Sweden, are *scythes* and *axes*. Their production was in former times throughout the country a common home-industry. By the adoption from abroad of improved models and cheaper methods of production, this manufacture can today well stand comparison with the American. The tools are made of cast-steel or of wrought-iron with steeled edge which latter method is probably at present the one most in use. As manufacturers of axes may be named Hult's iron works and those of the Uddeholm Co., and as a maker of scythes, Dahlgren in Eskilstuna.

As must naturally be the case, Sweden has, in consequence of the fine quality of its iron, several important productions of manufactured iron. Among them are especially to be noted *horse-shoes, horse-shoe nails, spikes,* and *screws*. Horse-shoes are still made in a great degree as home-sloyd; still there are at present

two horse-shoe factories with a produce-value of S 27,000. Horse-shoes are also made of the so called »Mitis»-iron, that is by the casting of wrought iron, which manufacture appears to have a promising future.

In consequence of the great tenacity of Swedish iron, it is especially suited for spikes and horse-shoe nails, and the malleability or riveting quality consequent on this tenacity has always been a marked characteristic of Swedish spikes. This malleability is naturally of great weight as regards the quality of horse-shoe nails. In 1890 there were in Sweden 6 factories for the production of horse-shoe nails with a yearly produce-value of S 275,000. In the same year spikes and nails were exported to the value of S 321,000, while the value of the imports amounted to S 218,000.

Iron and steel plate is to a great amount made into utensils of all kinds, for the dairy, for transport, for cooking purposes etc. In consequence of the great tenacity of Swedish plate, these vessels can be »whole-pressed», that is to say, produced of one entire piece by means of pressing between a stamp and a ring, by which method these vessels obtain more strength, than when they are manufactured by the method of soldering together many parts. But not only utensils but also decorative objects as *goblets* etc. are manufactured by »wholepressing», and Olofström's factory has won a just reputation for such plate-goods. Such pressed objects are finished by turning on a lathe upon patterns of different shapes, and then gilded or silvered, if they are intended for ornaments; cooking utensils are either tinned or enamelled.

In 1890, Sweden had 13 factories for tin-plate ware with a produce-value of S 300,000. In consequence of the great use of enamelled iron utensils for cooking purposes, the *sheet-copper* industry has latterly lost ground, so that in the same year there were but 3 factories for sheet-copper ware with a produce-value of S 1,100.

Concerning the metal or brass ware industry of Sweden it may be mentioned, that cast brass ware as well as *brass-plate,* and *brass wire,* is produced only at two places in the country, namely at Skultuna and at Gusum, but cast brass articles are also produced at a great number of the foundries and machine-works. Thus there were, in 1890, 31 *Metal* and *Bronze* factories with a produce-value of S 381,000. The manufacture of art objects cast from the metal called »cuivre-poli» has lately been introduced by Mr W. Wiklund at his metal-foundry in Stockholm. In spite of the short period during which this manufacture has been in process, the produced articles can fully compete in quality and cheapness with those from foreign countries.

But cast iron also is used for the production of objects of art. In late years especially have J. & C. G. Bolinder's Machine Works' Company in Stockholm, Ludvigsberg's factory in Stockholm and Husqvarna at Jönköping commenced to devote themselves to such *Art-casting* in iron, and have earned a well deserved reputation for their products. Many of these articles, such as decorative shields

and weapons of all sorts, compete with the chiselled in perfection of form, while the price is considerably lower.

The surface decoration of metal work by means of *chiselling*, or *engraving* and *etching* has also reached a very great perfection and the supply of such decorated articles in the market testifies to the high development of artistic work in this direction.

Carpentry, Joinery, Cork manufacture etc.

In consequence of Sweden's rich supply of timber, the **Carpentry** industry has developed to a considerable degree. The different productions are not confined only to the fittings of houses, — as windows, doors, verandas, panels and general mouldings, but have extended to the construction of *entire buildings* or villas in various styles and to the making of plain furniture, especially for garden fittings and miscellaneous house furnishing articles. Many consignments to abroad of entirely finished dwelling houses of wood have been shipped during late years, and great probability is that this branch of trade will increase, especially to warm climates. The buildings are fully finished in all parts, which are then numbered so that the whole may be easily reconstructed on arrival at its destination. Compare page 162.

Planed and moulded joinery articles (Swedish mouldings) are manufactured on a very large scale and form objects of an especially large export. Swedish timber produce, especially of pine, is in high repute in consequence of its white color, its freedom from knots and its straight fibred character.

In 1890, there were in Sweden 74 Joinery Works, with a produce-value of $ 2^1/_2$ million. In the same year, *joiners' work* in the form of house fittings was exported to a value of $ 558,000, and carpentry goods to the value of $ 335,000. The chief customers are Great Britain and France. Amongst the largest factories is Ekman's Machine Joinery Works at Sundbyberg outside Stockholm.

Amongst different factories, which to a greater extent produce different kinds of joiners' work, may be named:

	Number	Produce-value
Bobbin-factories	4.	$ 295,000.
Venetian-blind-factories	3.	31,000.
Blind-roller- »	2.	26,000.
Basket- »	4.	34,000.
Shingle- »	5.	60,000.
Wood Fibre- »	2.	9,000.
Barrel and Cask- »	10.	274,000.
Cork- »	15.	265,000.
Carriage- »	8.	34,000.

Cask Manufacture is certainly of very recent date, but has nevertheless in latter years considerably expanded, since suitable machines have been introduced in the place of time-losing hand labour. In 1882 was founded the first

factory for such purposes in Norrland, for the utilization of the timber waste from the saw mills. To-day such factories are built over the whole country. Both tight and slack barrels are manufactured, partly of fir and spruce and partly of harder kinds of wood such as oak and beech. Casks for the transport of both solid and liquid material, coops, tubs, wooden vessels for sanitary purposes, kegs, etc., are produced. In 1890 such goods were exported to the value of $ 8,000.

As may be seen above, **Cork** Manufacture takes a very prominent place among these industries, although the raw material has to be procured from southern Europe or Africa. This circumstance naturally depends upon the introduction of time and labour-saving apparatus for all the different processes, such as cutting, sorting, counting and stamping of the corks. In 1890 cut corks were exported to the value of $ 5,000.

Basket work was exported, in 1890, to the value of $ 19,000 and *Straw-work* to the extent of $ 35,000.

DEPARTMENT J.

ELECTRICITY AND ELECTRICAL APPLIANCES*.

Telephone, Telegraph, Electric Lighting, etc.

Telephone. Among the numerous branches of modern electrotechnics, the telephone has gained most ground in Sweden, and created an industrial activity which, in this special respect, places our country not only relatively, but absolutely on the same level as most of the far larger and more densely populated countries of the world.

As early as in 1877, the first telephonic connections were mentioned as existing in this kingdom, and their increase both in number and extent rapidly developed. In many of the large towns companies were formed so as to carry on telephonic activity; at some places, the telephone-network was erected by the *Royal Board of Telegraphs*, more especially in Skåne, the southernmost part of the kingdom. In most towns, boroughs, and more or less important places, the interchange of telephonic communication was arranged in another manner, so called telephone clubs being formed, founded on the simplest principles, being intended to place their members in telephonic communication with as many as possible, without any idea of deriving pecuniary profit. The payment was therefore often decided yearly, and was raised or lowered according to requirement; that it was not high, may be gathered from the fact that in more than 90 clubs, with a total of more than 5,000 apparatus, the yearly fee, on an average, was S 6·16. It must, however, be noted that the subscribers had themselves to defray the expenses of their own connection and apparatus. By degrees the telephone communications were still further extended; the central stations of the telephone clubs being connected with each other by independent wires to networks which in many instances extended over several provinces.

Communication by telephone was thus chiefly left to private enterprise. However from 1889 it may be said that things are changed. The State then by means of the Board of Telegraphs commenced to compete vigorously with the private lines, and by laying the interurban double wired lines between

* By N. O. W. Rahm, C. E.

the more important towns and places, and by the purchase of private networks the *State Telephone* has developed to an enormous degree and replaced many of the afore-mentioned telephone clubs, or telephone companies. These, notwithstanding their merits concerning telephony, have generally been handicapped by very considerable faults and disadvantages, chiefly caused by the want of unanimity when building and managing the lines. In spite of the higher fee charged for State Telephone intercommunication, it has therefore generally been found more profitable to allow the State Telephone to assume the whole. The Diet, understanding the great importance of this new means of communication, has generously granted large sums to the State Telephone. The central and southern parts of the kingdom are already connected by double wired lines. In the North many such connections are made, and in a short time will be still further extended and completed. At the close of the year 1891, the network of the State Telephone intercommunication included 235 central and district stations; the combined length of the wires being more than 22,700 kilom. (14,100 miles); the number of apparatus in use being 10,249, of which 386 were at the stations and 9,863 used by the subscribers.

Among the *private* enterprises there can be no doubt but that the *Stockholm General Telephone Co.* occupies the very foremost position. Its central station may be considered one of the largest and best arranged in the world. Originally intended for 7,000 lines it can now, in consequence of certain alterations, open as many as 10,000 lines. At the close of 1891 the company had about 6,700 subscribers. The total length of private telephone wires, at the same time, was 38,000 kilom. (23,600 miles) with 392 centrals and 14,800 apparatus. Thus in the entire realm there were more than 60,000 kilom. (37,260 miles) of telephone connections, 600 centrals and district stations and 25,000 telephone apparatus in use.

A comparison with some other countries will best show the advance made by the telephone in Sweden. In 1889 there were about

	Per apparatus Inhabitants.	Per kilom. wire Inhabitants.
Sweden	240	100
Switzerland	200	200
Norway	360	300
Germany	700	500
Belgium	1,100	600
Spain	2,100	1,700
Austria-Hungary	4,900	1,400
Russia	14,200	6,200
Sweden, at the end of 1891	190	80

Telegraphy, from the very first has been undertaken on behalf of the State by the Board of Telegraphs. At the close of the year 1891 there were 8,820 kilom. (5,480 miles) of lines and cables, and 23,445 kilom. (14,560 miles) in wires, the telegraph stations belonging to the State being 179 in number. To

these, however, must be added numerous telegraph lines which are run by railways for their own needs, but which are used by the public, though not to any very great extent. In 1891 there were 862 such railway telegraph-stations connected with the State Telegraph Offices, and should the few private lines be counted, the whole number of the telegraph offices in communication with each other would amount to 1,045.

As a general rule the offices are adapted for the Morse system with ink-writers. Between the larger offices such as Stockholm, Gothenburg, Malmö, Sundsvall and Luleå apparatus of Wheatstone's rapid system are used. These same stations, as also those of Gefle and Norrköping, are fitted with Stearn's apparatus for duplex-telegraphy.

The telegraph *apparatus*, as also that for telephoning, small and multiple switch boards, and by-apparatus are made by L. M. Ericsson and Co. of Stockholm, whose manufactory, by excellent work and relatively low prices, has essentially helped to make the telephone popular, and occasioned its rapid spread. At the manufactory about 260 workmen are employed, and in 1891 no less than 7,100 telephone apparatus were manufactured, nearly 3,000 being exported. The number of switchboards, large and small, made during the same year was 222, of which 68 were sent abroad. The manufactory also turns out *testing instruments, fire-signalling apparatus*, as also diverse other electric apparatus such as water-level-gauges, anemometers, controls for watchmen, etc.

Unlike the telephone industry which, from the very first, has almost entirely been a home one, the installations for electric lighting have (at least during the first period) chiefly been undertaken by J. E. Ericsson's Machine Manufacturing Co. and the firm of Luth and Rosén of Stockholm, mostly with foreign materials. The home industry was, with but few unimportant exceptions, simply represented by the General Swedish Electric Co. in Vesterås (late Electric Co. of Stockholm) which has secured the patent of Wenström's well-known dynamo-machines, and from an unassuming commencement has developed, according to our circumstances, to a very important electro-technic business, both for making dynamo-machines and other material, and in electric light and installing power plants. It may be mentioned that electric ore-separators have been made by the company. More than 125 workmen are employed at the Works, in 1891 there being 65 dynamo-machines sold, 12 being for transmission of power. Altogether during the year mentioned, the company put up more than 6,000 incandescent-lamps and close upon 100 arc-lamps. Greater activity has, however, been displayed of late in this branch of industry, as electric dynamo-machines and motors, as well as other material, are now made, and lighting and power plants undertaken by several firms, viz. W. Wiklund, G. de Laval's Steam Turbine Manufacturing Co. in Stockholm, as also Wockatz & Co., and Edvin Andrén & Co. of Gothenburg; the last-mentioned firm also making accumulators according to E. P. S. system.

At the close of 1891 the total number of electric incandescent-lamps in the kingdom may be reckoned as 160,000, the number of arc-lamps being 1,800. In Stockholm there were 20,000 incandescent-lamps and more than 300 arc-lamps. The chief plant for electric light is the so-called Central station, newly opened in Stockholm, where the threewires system, with steam dynamos and accumulators, is used. The mains are laid underground and are calculated for 12,000 lamps burning simultaneously, but the central station may be greatly extended. Besides this establishment for electric lighting which belongs to the City of Stockholm, there are many smaller stations, and also industrial establishments, as well as public and private buildings, which have installations of their own for electric light. In many of the towns and boroughs of the kingdom, besides the capital, there are stations for lighting larger or smaller portions of their precincts. In Sundsvall and Helsingborg the conductors are laid underground, but otherwise aerial conductors are almost universally used as in Hernösand, Östersund, Falun, Vesterås, Eskilstuna, Arboga, Borås, Gothenburg, Halmstad, Malmö, Vexjö, Filipstad, Marstrand, Motala, Bollnäs, the two last-mentioned places using alternating currents of high potential with transformers.

Electric *incandescent-lamps* were made in this country as early as 1885 in Södertelge by R. W. Strehlenert, the manufacture having since been moved to Stockholm and by degrees greatly increased, extended, and improved. The price of the lamps made has been lowered from that of 1885, which was 80 cents, to an export price at the present moment of but 17 cents, while their quality is in every respect perfectly good and can bear comparison with the very best products of foreign countries. In 1891 the manufacture of incandescent-lamps was above 108,000 and can now reach a maximum of 3,000 a day. The works, which employ about 50 hands, are now the property of a company, the Incandescent Lamp Manufacturing Co. of Stockholm. The manufacture of incandescent-lamps has, of late years, been also undertaken to no small extent by W. Wiklund of Stockholm, and the Svea Works, at Sundbyberg, in the immediate neighbourhood of the capital.

Conducting wires and *cables* for telephone demands, as also certain kinds of conducting material for the installation of electric light are made by Max Sievert in Stockholm. The works, which were opened in 1888, have been greatly extended and completed since that time, and are now provided with machines of the very best and latest construction, about 60 workmen being employed.

It might be expected that in Sweden, with the plentiful supply of unused waterpower, the electric transmission of power would have been used extensively. Such is however not the case, the transmissions already in use being but few, and comparatively unimportant, both as regards distance and power transmitted. Interest is now more generally felt for these transmissions and greater confidence is shown in them, so that a brisker activity in this branch of electro-technics may be expected, more especially if the Government — to whom numerous applications have

been addressed concerning permission to carry out such transmissions of considerable extent — should favour the idea and not impose too stringent restrictions.

The **electric railways** are neither numerous nor important. Those hitherto established at the Boxholm Works, Vermbohl Paper Mills and at Skutskär Saw Mills and Korsnäs Planing Mills, near Gefle, are all lines of small extent, destined for transport within the premises of the works, or to the harbour, or railway station. There is, however, a longer line in process of construction between Stockholm and Djursholm, the distance being 12 kilom., and some other lines are proposed.

In conclusion, mention must not be omitted of a pretty extensive fabrication that takes place in this country of **galvanic elements** and carbon therefore, more particularly by Rylander and Rudolph's Manufacturing Co. at Henriksborg, in Stockholm, as also that at many establishments of different kinds, among which some are of comparative importance, an electro-chemical industrial activity has arisen for gilding, silvering, nickel-plating, or for other purposes.

DEPARTMENT K.

FINE ARTS — PAINTING, SCULPTURE, ARCHITECTURE AND DECORATION*.

The Royal Castles have played a very prominent part in the development of Fine Arts in Sweden. In mediæval times the Church was the chief patron of Fine Arts, and the grand cathedrals of Lund, Upsala, Linköping, Skara, Strengnäs, Vesterås etc. are unquestionably the principal monuments now left to us of mediæval art. At the time of the Reformation, the introduction of the new, monarchical mode of government, and the accession to power of the Vasa family, in short at the beginning of the Modern Age, the Royal Castles became of importance, and the king and royal family for a considerable length of time were the chief encouragers of the Fine Arts. Not only architecture but also painting, sculpture and the other Arts are connected with the Royal Castles.

Thus painting found its first home in our country at the large country-palace of Drottningholm, erected by Queen Hedvig Eleonora on an island of Lake Mälaren (begun in 1661). The chief artist there was Ehrenstrahl (1629—1698); of German origin, he had studied art in the Netherlands and Italy and was at the head of a numerous school, excelling in portraits and allegorical paintings, which still existed at an advanced period of the 18th century.

The building of the castle was commenced by Nikodemus Tessin, who was invited from Germany, and finished by his son of the same name (1654—1728).

Still greater importance in respect to architecture as well as to the general development of the Arts in our country must be attributed to the erection of the Royal Palace in Stockholm, the architect of which was the above-mentioned Nikodemus Tessin Jr., the greatest architect ever found in Sweden. The building was commenced in 1697, but was not completed before the latter half of the 18th century, on account of numerous interruptions of long duration.

The decorative elements of this large building were principally furnished by foreigners, such as the sculptors J. Ph. Bouchardon (1711—1753) and P. H. L'archevêque (1721—1798), and by the painter G. Th. Taraval (1701—1750). As can be seen by the names themselves, the artistic ability required was summoned

* By Dr. G. GÖTHE.

mostly from France, as the French taste was the predominant one of the whole century, in our country as over all the European continent. And this taste found a new home in the Academy of Fine Arts now established in Stockholm with the assistance of the French artists. In 1735 the »Royal Academy of Drawing» was founded, still existing in an extended form and at present called »The Royal Academy of Fine Arts». The Academy was originally instituted for promoting harmonious intercourse between the artists engaged in the grand works of the Palace, and for the purpose of fostering young native artists under the tuition of those from abroad; thus the building of the Palace may be considered an impulse for the introduction of the academic institution in our country.

Apart from the cooperation required from painters and sculptors for the monumental decoration of the Palace of Stockholm, mostly smaller tasks, particularly the execution of portraits, were assigned to our artists. To be sure Gustavus III (1771—92) caused his French architect and ornament painter L. J. Desprez (1737—1804) to execute the plan of a magnificent country seat at Haga (outside Stockholm), but the building never went further than the foundations. In lieu of this the new Opera House of Stockholm, certainly of a less ambitious design, was erected in 1782 by the clever Swedish architect C. F. Adelcrantz (1716—1796), who also built the Church of Adolf Fredrik, in modern classic style.

During the so-called Era of Liberty (1718—1772) and the Gustavian period (1772—1809) a great many skilled portrait painters were to be found: the pastel painter Gustaf Lundberg (1695—1786), the painters in oil L. Pasch Junior (1733—1805), P. Krafft Senior (1720—1793), A. Roslin (1718—1793), A. U. Wertmüller (b. 1751, † 1812 in Philadelphia), C. G. Pilo (1712—1793) and C. F. von Breda (1759—1818), the miniature painters N. Lafrensen Junior (1737—1807), P. A. Hall (1739—1793) and others. After the middle of the 18th century the larger number of artists engaged in Sweden were natives, not foreigners as was formerly the case. But on the other hand it may be observed that many of the most prominent artists went abroad, naturally mostly to Paris, not only for the development of their talents but also for the purpose of settling there at the conclusion of their studies, in order to acquire fame and riches. This was the case with Roslin, Wertmüller, Lafrensen and Hall amongst others. A very few would, like C. F. von Breda, the pupil of Reynolds, pursue their studies in the English school. Amongst these latter may be mentioned Elias Martin (1739—1818), who by studying from Wilson, Gainsborough and other artists belonging to the original and romantic landscape-school of England was the first landscape painter of note in our country. On the other hand, P. Hilleström (1732—1816) by studying the French school (Boucher, Chardin) became the first Swedish genre painter in the modern sense of the word.

The sculptor Johan Tobias Sergel (1740—1814) was unquestionably our most notable artist in the latter half of the 18th century. After completing his first studies at the building of the Palace of Stockholm as a pupil of the above men-

tioned L'archevêque, in 1767 he went to Rome, where he became one of the earliest pioneers of modern sculpture, nursed in a severe antique school, and the predecessor of Canova and Thorvaldsen. As far as can be judged, the process of his development was somewhat disturbed, when in 1778 he was summoned back to Sweden by Gustavus III from his successful work in Rome and retained in Sweden for the rest of his life († 1814). The best and largest piece of work here executed by him was the monumental bronze statue of the king, now placed at the »Skeppsbron» in Stockholm. By its spirited bearing and pure outlines it is in favorable contrast to the statues of Gustavus I and Gustavus II Adolphus executed by L'archevêque, the teacher of Sergel, in French rococo-style and also placed in the capital, as it ranks foremost among the numerous monumental statues afterwards erected in Stockholm and other cities of Sweden.

This modern-classic style, the principal exponents of which, in regard to sculpture and architecture, were Sergel and Adelcrantz, did not show a corresponding degree of vitality with respect to painting and the graphic arts, in L. Masreliez (1747—1810) and his pupil F. Westin (1782—1862), but was nevertheless the predominant style from the time of Gustavus III down to the middle of the 19th century.

This period, the earlier part of our century, must on the whole be considered one of inactivity. Fresh impulses came first from the literature of the age, viz. the national and the romantic school (Tegnér, Geijer, Ling, Atterbom) and by the renewed studies abroad of the Swedish artists. In Rome B. E. Fogelberg (1786—1854) chiselled his magnificent marble statues of the Old Scandinavian gods, Odin, Tor and Frey, and later developed his talent for historic portrait sculpture (the bronze statues of Gustavus Adolphus II in Gothenburg, Birger Jarl and Carl XIV Johan in Stockholm); his successors were C. G. Qvarnström (1810—1867) and J. P. Molin (1814—1873) whose works represent subjects from Scandinavian fairy tales or from the history of Sweden. (Qvarnström: the statue of Esaias Tegnér in Lund; Molin: the large fountain and the statue of Charles XII in Stockholm.)

Like these sculptors, the Swedish painters of the period 1820—1850 turned their steps principally to Rome, where they learnt to depict southern landscape and figure-subjects in the idealistic style of that time. Amongst these were the figure-painters A. Laureus (1783—1823), Hj. Mörner (1794—1837), O. J. Södermark (1790—1848), C. G. Plageman (1805—1868) and others; the landscape painters G. W. Palm (1810—1890), J. M. Stäck (1812—1868) and others.

Other artists, colorists and realists, to a greater degree remained for a longer time in Paris; such were the animal-painters C. F. Kiörboe (1800—1876) and J. W. C. Wahlbom (1810—1859) and the landscape-painter P. G. Wickenberg (1812—1845). Others again, at the close of the period, divided their time between Munich and Paris, as the figure-painters J. C. Boklund (1817—1880) and J. F. Höekert (1826—1866).

From the beginning of 1850 and after the settling at Düsseldorf of two

remarkable Norwegian painters, the genre-painter A. Tidemand (1814—1876) and the landseape-painter H. Gude (1815—) still living, that town beeame for a time the favourite resort of our painters. Especially a great number of genre-painters studied in this plaee. Amongst these we may note C. H. L. d'Uneker (1828—1866), F. Fagerlin (1825—), A. Jernberg (1826—), B. Nordenberg (1822—), Amalia Lindegren (1814—1891). The landscape painters were inferior in number. The most remarkable of these are: J. E. Bergh (1828—1880), A. Nordgren (1828—1888), G. Rydberg (1835—), P. D. Holm (1835—) and H. A. L. Wahlberg (1834—).

The latter artist however soon removed to Franee (1867), where he beeame a prominent adherent of the modern eoloristie and impressionist school of landseape, whieh, led by Corot, Daubigny and others, had gained ground, and whieh during the period 1870—1880 had been more and more followed by the young generation of Swedish artists.

In the meanwhile an artistie aetivity had eommeneed here in Sweden. The Swedish Art Association, founded in 1831, endeavoured to exeite the artistie interests of the publie by the arranging of exhibitions and the purehase of pietures. The Royal Academy of Fine Arts was reformed by Qvarnström and Boklund; lessons in painting were now given to the pupils (formerly the lessons ineluded only drawing and modelling), a special class for landseape-painting was added, and ladies were admitted as pupils. In 1866 the new National Museum of Stoekholm, containing the principal treasures of art belonging to the State, was opened. And in Carl XV (regent 1859—1872) the eountry possessed a patron of fine arts, himself an artist (landscape) who gathered around him the artistie abilities of the eountry.

Architeeture, hitherto negleeted, took a new departure in A. Nyström (1793—1868) and still more in F. W. Seholander (1816—1881, also a painter in water eolors, draughtsman and poet), and a great aetivity was shown, partieularly by the painters. Besides the genre, animal and landseape painters above-mentioned, we may note U. Troili (1815—1875) as portrait painter, J. A. Malmström (1829—) and M. E. Winge (1825—) who sueeessfully adopted the example of N. J. Blommér (1816—1853) of illustrating by the brush the subjeets of the Old Northern myths. Nor should we omit the gifted painter and great traveller E. Lundgren (1815—1875) who beeame a prominent artist in water eolors by studying in Italy, Spain, England and India, and Count G. von Rosen, still living (1843—), who after having studied with the renowned H. Leys of Brussels, has been equally sueeessful as historieal- and portrait-painter. In oils, as well as in water eolors and etehings, he has produeed spirited pietures, prineipally from the renaissanee period of Sweden.

From a still younger generation of historieal painters we may note the lately deceased C. G. Hellqvist (1851—1890), who also has painted pietures, sometimes of large size, depieting seenes from the Seandinavian renaissanee and mediæval

age, and Baron G. O. Cederström (1845—), who has chosen his subjects chiefly from the »Carolingian» period (end of 17th and beginning of 18th century); he also has executed several pictures of large size.

In Julius Kronberg we possess a colorist of great imagination, who has prineipally produced allegoric compositions and of late (1891—92) has executed two large and magnificent plafond-paintings in the Royal Palace of Stockholm.

A happy talent for monumental painting has likewise been displayed by the variously gifted artist C. Larsson (1853—), draughtsman, painter in water colors and in oils, particularly by his wall-paintings in a Gothenburg school for girls. He belongs to the numerous group of younger artists who chiefly having pursued their studies in France and, in eonnexion with the »plein-air» school and other still more advanced methods in the contemporary French style of painting, have to some degree beeome opposed to earlier traditions and to the Academy. Disagreements similar to those occurring in most of the contemporary schools of art in Europe have arisen in our country.

In this modern style of painting the ancient divisions: historical, genre and landscape painting are not as strictly separated as in the earlier style. The artists perchance prefer representing figure scenes in the open air, where the landscape and the figures (both men and animals) play parts of about equal importance, they generally choose small subjects though painted on a large scale and chiefly aeeentuate the treatment of the air. As the most gifted might be mentioned: H. Salmson (1843—), A. Hagborg (1852—), H. Birger (1854—1887), E. Josephsson (1851—), G. Pauli (1855—), A. Österlind (1855—) and L. Zorn (1860—), a very virtuoso in oils, water colors and etching, and who has acquired a reputation both in France and England. In R. Bergh (1858—) the group possesses a distinguished portrait-painter. O. Törnå (1842—), P. Ekström (1844—), W. von Gegerfelt (1844—), J. Krouthén (1858—), K. Nordström (1855—), C. Skånberg (1850—1883), A. Lindman (1848—) and others, paint nothing but landscapes and marine subjects. Lastly B. Liljefors (1860—) is a highly gifted animal painter, a daring colorist and close observer of the northern fauna.

Freneh art is still the foreign style exercising the strongest influence on our youngest generation of artists, especially the painters. However the numerous colony of Swedish artists collected in France in the decade 1880—90 has been considerably reduced. Even those, who like A. Wahlberg, H. Salmson, L. Zorn and the historical- and portrait-painter N. Forsberg and others, are still resident in France, generally spend much of the lighter and warmer season in their native country. B. Nordenberg, F. Fagerlin, A. Jernberg and his son the landscape painter O. Jernberg (1855—) are still living in Germany (Düsseldorf), and the genre painter Baron Th. Cederström (1843—) is resident in Munich. But on the whole the Swedish painters are at present more numerously assembled in their native country than has been the case for a long time.

In order to complete our rapid survey of the painters, amongst the artists

as yet not mentioned we ought to remember the figure-painters O. Björck (1860—), A. Jungstedt (1859—, also landscape painter), Mrs H. Thorell (1850—), J. Tirén (1853—), A. Borg (1847—) and A. Wallander (1861 –); the landscape painters: O. Hermelin (1827—), O. P. U. Arborelius (1842—), V. Forssell (1846—), A. M. Lindström (1849—), E. Rosenberg (1858—), J. Kindborg (1861—), C. Flodman (1863—1888) and A. Schultzberg (1862—). Here, as abroad, pastel-painting has lately been cultivated with fresh interest and, amongst others, by the above-named A. Wallander and J. Nyberg (1855—). Finally it should be noticed that in contemporary buildings, and especially in the numerous restorations of ancient monumental buildings, churches and palaces, painting has been frequently used as a decorative element. A. Lindegren, architect (1858—) may be named as the most remarkable artist of this kind.

Also with regard to the art of engraving an increasing activity is now displayed. The ancient art of copper engraving which was skilfully represented by L. Ruben († 1875) is certainly out of use. On the other hand the art of etching is successfully practised by many artists, incomparably more numerous than at any previous period. Besides the painters above-mentioned, viz. L. Zorn, C. Larsson, G. von Rosen, and O. Jernberg, we may further note the landscape-painters A. T. Gellerstedt (painter in water colors and also poet, 1836 —), T. Hermelin (1856—), J. Hägg (marine-painter, 1839—), R. Norstedt (1843—) and further A. Andersson (1859—), Mrs C. Benedicks-Bruce (also sculptor, 1856—), G. F. Boberg (also architect, 1860—), G. Gustafsson (1852—), R. Haglund (1844—); A. H. Hägg (1835—) and A. Tallberg (1860—), the last two both living in England.

In connexion with this, the fact may be mentioned of the great extent to which graphic art in general is employed by literature and the press of our country for the purpose of illustration. As illustrating artists we may note, besides the above-mentioned C. Larsson and A. Malmström, Mrs J. Nyström-Stoopendal (1854—), and as xylographists: K. Andersson (1853—), Ida Falander (1842—), G. Forssell (1859—), Mrs Thekla Nordström (1855—), J. Peterson (1860—), O. Sörling (1852—) as well as V. Bernström (1845—) and J. Engberg (1833—) the two latter living in America (New York). Of the numbers of firms which execute photomechanical prints, the Litographic Establishment of the General Staff and W. Silfversparre, both in Stockholm, are worthy of prominent notice.

The highest class illustrated paper of Sweden is the »Ny Illustrerad Tidning», New Illustrated Gazette, (editor O. Granberg). A special Association for Graphic art, »Föreningen för grafisk konst», is (since 1887) working for the promotion of this art.

In sculpture Qvarnström and Molin were succeeded by J. F. Kjellberg (1836—85) whose most popular work, the bronze statue of Linné, is also known, by reproduction, in America. His position as Professor of the Royal Academy is now filled by J. Börjesson (1835—), who beside other works has executed the monumental statues of Holberg, the poet (in Bergen), of Geijer, historic author

and poet (in Upsala), of the statesman Axel Oxenstierna (in Stockholm), and of the chemist v. Schéele (in Stockholm). Of the younger sculptors we may mention: O. Berg (1839—), A. E. Brambeck (1843—), A. Nyström (1844—), I. Fallstedt (1848—) and, younger still, K. P. Hasselberg (1850—), particularly popular by his beautiful marble statue »The Snow-drop», J. Th. Lundberg (1852—), W. Åkerman (1854—) and Chr. Eriksson (1858—).

Also, with regard to sculpture, the antique traditions formerly prevailing have been effaced, and have been replaced by more realistic and picturesque tendencies, at least, as regards the younger artists.

Mrs L. F. Ahlborn (1826—) has for a long time been successfully practising medal engraving. A somewhat younger representative of this art is J. A. Lindberg (1840—), a prominent artist.

As a final review of the fundamental art, viz. architecture, we may note that the leadership of our school of architecture after Scholander was taken by H. N. Zetterwall (1831—), a man of solid talent, principally employed at the restoration of several ancient monumental buildings in our country, as the cathedrals of Lund, Linköping, Upsala and Skara. Beside him we may mention: F. G. A. Dahl (1835—), E. A. Jacobsson (1839—), H. T. Holmgren (1842—), C. A. A. Grundström (1844—), and of a still younger generation: L. Petersson (1853—), G. Clason (1856—), C. Möller (1857—), J. F. Lilljekvist (1863—) in Stockholm, and in Gothenburg A. Pettersson (1835—) and H. Hedlund (1855—).

Finally we must not omit the mention of the young architect of the Swedish Pavilion at the World's Columbian Exposition 1893 at Chicago; his name is Gustaf Wickman (1858—).

Generally a considerable degree of activity is at present displayed by the Swedish architects. There is no fixed style predominating in their works, though many of them have skillfully assimilated the forms of various ancient styles, to make use of them in a deliberate way, and not without independence, for their own works.

It is wonderful to see how these architects with their handsome building-plans, are able to induce the builders, even many private ones, to erect rather expensive structures of solid materials, as bricks (»Rohbau»), sandstone, limestone and granite; the architects also employ clever stone masons for executing the elegant reliefs around the porticos and other prominent parts of the building.

DEPARTMENT L.

LIBERAL ARTS — EDUCATION, LITERATURE, ENGINEERING, PUBLIC WORKS, MUSIC AND DRAMA.

Physical Development, Training and Condition*.

Gymnastics. An important means of education for the youth of the nation is to be found in the celebrated Swedish Gymnastics, which during the last few decades have gained an ever-increasing number of adherents, even outside the country of their origin. In Swedish education indeed they are a marked feature, in as much as they form a part of the obligatory curriculum at every school. Their good effects leave their impress, it may be said, on all the cultivated portion of the nation, and find their most attractive expression in the good bearing which generally characterizes Swedish school-boys.

The Swedish system was founded by P. H. Ling (1777—1839), a patriot, gymnast, and poet who was inspired with a desire to revive the ancestral spirit in the Swedish people by the help of sport and song, to draw out once more the great qualities, the strength, the courage and the will, which in old times had distinguished the Scandinavian race. After a hard struggle he succeeded, in 1814, in founding the State institution still existent and known as the *Royal Gymnastic Central Institute*, where all teachers of Gymnastics throughout the country receive their training. And to this establishment are due the uniformity and homogeneity which mark Swedish instruction in this subject. The Institute, it may here be observed, works in three directions, teaching ordinary gymnastics for pedagogic purposes, as well as military and medical gymnastics for their respective ends. A complete training in all three branches entails a course of three years.

Ling's creative genius produced a system based on ordinary physiological laws, which was afterwards further developed by his pupils and successors. The great end and aim of the system was general social education from a physical, moral, and disciplinary point of view. Its distinguishing qualities are simplicity, naturalness, and, so to say, truth. Its exercises are such as to exclude none from partaking in them, as they may be adapted to every individual disposition and measured to suit varying degrees of strength. The system calls indeed for uni-

* By Captain V. Balck, Dr. A. Wide and Dr. A. Levertin.

versal participation, and at school for instance, not even the sickly and deformed are set aside, but are subjected to special exercises calculated to meet their special wants.

The daily exercises, according to the Swedish system, are intended to promote a symmetrical growth of all parts of the body and only such movements therefore are admitted as can be shown, by anatomical and physiological laws, to be of real benefit to this end. Their aim is, first and foremost, bodily health and harmonious development. For this reason the movements are divided into classes according to their effect upon the human body, while the individual movements of each class are arranged in order of progression to follow the growing strength and proficiency of the pupil.

The same system is followed throughout the country, at public and private schools alike, as well as in the army and navy; and at all State schools, upon which the teaching of gymnasties is entailed by law, the instruction is subject to the inspection of the »Central Institute».

In all the larger towns too there are independent gymnastic clubs and associations, which enable young men to continue their exercises after they have left school. These clubs are generally guided by instructors, graduated at the Central Institute, and the same system is still followed, though with due regard for the greater amount of skill and strength which may be demanded of fully developed men. These clubs also often extend their practice to what may be called applied gymnastics, with the object partly of introducing a more sporting and amusing element, and partly of obtaining a measure of individual development and power.

Lately gymnastic associations for women have been formed, and among these especially are to be noticed those for women of the working classes.

Fencing and sword- and bayonet-exercises are of course practised in the army and navy and the schools of the two services, as well as in amateur clubs in the larger towns. At the higher public schools fencing and sword-exercise are also taught.

A special branch which has largely contributed to give to the Swedish system its well deserved repute, is the *Medical Gymnastics* and art of *Massage* now so well known throughout the world. Swedish experts, trained to this profession, are to be met with in America as well as all the countries of Europe, wherever, in fact, the course of civilization renders this remedy necessary for certain of the maladies which follow in its train (see pages 196 and 198).

Sport in Sweden is of old descent. As is well known, the warlike, rapacious Vikings were the greatest sportsmen of their day and there are some sports and national games which have been handed down by them and have never died out. Modern sports on the other hand are of very young growth in Sweden, though, as late years prove, their youth is a youth of vigour. An infinity of clubs of all conceivable characters have been established and show undoubted signs of life and strength.

Winter sports are at the same time the most truly national and the most popular. This is especially the case with *Skating,* the origin of which lies in the very distant past. It is almost a matter of course that every educated Swede can skate, thanks to the great plenty of lakes and other water with which Sweden abounds, and to the severe winter which makes the pursuit possible from December to March or April. Excellent rinks are to be found in all the larger towns, Stockholm alone having five. The chief of these, that belonging to the »General Skating-Club», is large enough to accomodate 5,000 skaters, and the illuminations give to the evening skating here much of the aspect of a popular fête. Here too contests are annually held, national and international, in racing and figure-skating, and several records for the world have been set by Swedish skaters here as well as abroad. During last winter Swedish skaters were winning the championship of Europe as well in speed- as in figure skating at the international contests at Berlin.

The second great winter pastime is *Snowshoeing,* than which the whole world can show no grander or healthier sport. It is fully national in the north of Sweden, where all, men and women alike, are at home on their snow-shoes. Of late years too snowshoeing has been revived by the efforts of amateur clubs in Central Sweden and annual contests are held at Stockholm and elsewhere in racing, jumping, and other tests of skill. The length of the jumps achieved varies from 20 to 60 or even 70 feet and the perpendicular falls sustained in the course of such a jump are equal to the height of a two-storied house.

Ice-yachting and *sailing on skates* are two sports which are also very commonly practised as long as the snow leaves the larger expanses of ice uncovered. Rates of speed, which are quite incredible, are attained by these skaters and it is a peculiarly fascinating sight to see the mirror-like surface of a great lake or bay covered with skaters flying in various directions, literally with the speed of the wind.

The commonest sports of the summer are *Sailing* and *Swimming.* As to swimming the same can be said as about skating, that every educated Swede can swim. There are excellent institutions for the purpose in many places and here the young folks are tested for the swimming-degrees of »candidate» and »master». The annual »degree-day» at Stockholm is a most popular national festival, and here men of fifty or sixty are crowned with bay or willow in celebration of the jubilee of their degrees. Swedes are renowned for their fine bold dives from a height of 40 or 50 feet, and even girls may be seen practising this formidable feat with astonishing nerve and skill.

Sailing is perhaps the most favorite of all Swedish sports and there is a large number of clubs devoted to the pastime, round the long Swedish coast with its deep inlets and fringe of islands, as well as on the large lakes so common inland. The prevailing taste is no doubt inherited from our sea-faring ancestors, the Vikings, and Swedes have the character of good sailors over the whole world, as the New York Yacht Squadron can well testify. The »Royal Yacht Club»

which enjoys the patronage of His Majesty the King, is the first in Sweden and numbers 554 members and 158 sail, large and small. Other considerable clubs exist in Stockholm, Gothenburg, and elsewhere.

Rowing-clubs after the English pattern have latterly sprung up in most of the important towns, and Swedish crews have several times won in the inter-Scandinavian races. Swedish waters are indeed particularly suitable for the practice of the sport. English light boats are generally used, though more open water sometimes makes more roomy craft necessary. Most of their boats are built in Swedish yards.

As for *canoeing*, especially *canoe-sailing*, which is also a flourishing sport, the unanimous opinion af English travellers declares that no country in Europe is better suited for the purpose than Sweden, and one of them goes so far as to designate it »the paradise of the canoeist». Canoes of various types and materials, of wood, canvas, papier maché, and even brass, are also built in the country.

The large group of exercises and contests which correspond to the *Athletic Sports* of England and America have gained a good footing in the country and are regarded with great interest in the army and navy on account of their value as a means of education and development. Running, walking, jumping, pole-jumping, wrestling, tug of war, putting the shot, and throwing the spear are the chief of these exercises. There are clubs which hold annual competitions of this kind and the Stockholm garrison Athletic Meetings are especially popular. Latterly contests of five events, resembling the »Pentathlon» of the Greeks, and including running, jumping, wrestling and throwing of the discus and the spear, have been introduced. Athletic clubs of a somewhat different type are also a recent introduction, weightlifting and similar performances being the exercises practised.

Of old *National Games* some still survive among the people in certain parts of the country. They flourish especially in Gotland, where they have preserved their form unchanged for centuries. In Gotland »Pärk» holds the place of honor, a peculiar ball-game which allows the ball to be either kicked with the foot or struck with the hand. In its organization and good qualities it may even be compared with cricket and baseball. The »Varpakastnings is a kind of quoit or discus game, in which flat stones are thrown at a mark. »Störta stång» is a very ancient Gotland sport, much resembling the »tossing the taber» of the Scots. Annual competitions in these games are held at Visby, under the direction of clubs in the town, at which representatives from the various parishes of the island meet and try their skill and strength together.

Shooting and *hunting*, in the general sense of the term, are old and of course fully national sports in Sweden. Clubs and associations for their advancement are universal. The pursuit of game is in fact the oldest of all our sports and has always flourished in the forests and on the shores of lake and sea.

Fishing as a sport has never been much practised, though the salmonfishing

round the coasts and in the great rivers is excellent, and the lakes on the whole are well-stocked with other fish (see page 93).

Of *literature*, besides the works of Ling, there are several Manuals dealing with Swedish Gymnastics and in several languages, and a magazine, »Tidskrift i Gymnastik», is published in the same connexion. Sporting literature has been plentiful of late years and includes the »Illustrerad Idrottsbok» or »Illustrated Book of Sports», a work treating all branches of the subject. Manuals of rowing, swimming, archery, skating, sailing, shooting, and other sports have been published. The Swedish association for shooting and hunting, »Swedish Hunters Club», has been issuing a very valuable magazine for the last twenty years, and »Tidning för Idrott» or »Sport Journal» is a weekly sporting paper of wide scope which has been established for twelve years. There are also other sporting periodicals in circulation.

Manual Gymnastics. This mode of treating diseases according to P. H. Ling's (see page 192) method is derived from and founded on his pedagogical system, being often called manual gymnastics to distinguish it from the mechanical. In Sweden there are two training colleges for medical gymnastics, both in Stockholm, viz. the aforementioned Gymnastic Central Institute and the Gymnastic Orthopedic Institute; the latter has been an institution of the State since 1827. At the Gymnastic Central Institute each year 10 to 15 male kinesipathists and every other year 25 females take their final examinations. The course for the kinesipathists — embracing educational gymnastics also — occupies a time of 3 years for the male and 2 years for the female pupils; the requirements for admission being for the former the course prescribed for matriculation at a university, and for the women a corresponding examination passed at some high-school for females. There is, however, a course of but a twelve-month for physicians. At the *Gymnastic Orthopedic Institute*, physicians and medical students are instructed; special educational courses being held for this purpose in the autumn and spring, and as about 30 persons can attend each course, every Swedish physician becomes versed in medical gymnastics. In addition to the two State Institutions there are institutes for manual gymnastics in almost every town; and during the summer at every watering-place in Sweden. Every kinesipathist, who has past his final examination, and been acknowledged by the Royal Medical Board, may open a kinesipathic institute in conjunction with a physician.

The Swedish *kinesitherapy*, or movement-cure, embraces active, passive, and so-called resisting movements, which latter are peculiar for the Swedish system. The movements of resistance are a kind of active movement, when a constant interchange of muscular action takes place between the gymnast and the patient, the former, however, deciding the force of the movement. The Swedish kinesitherapy embraces the usual massage treatment, for which reason it is in Sweden deemed that massage is simply an integrate part of the movement cure, though

it is aeknowledged that this part has been greatly extended by Metzger and his followers.

Kinesitherapy was at first almost entirely used simply for internal complaints, mostly for those of eireulation, respiration, and the digestive organs; by degrees, however, the deformities of the human body began to be treated by this eure, more especially those of the spine and the extremities; and afterwards it was employed as an after-eure following on exterior injuries, such as stiffness of the joints, weakness of the muscles, etc. The movement-eure according to Ling's system is now used at our clinies, more especially when treating nervous disorders. When the patient has been in bed for some time, or where convalescence is retarded, in cases of decrepitude and other state of ill-health, these movements replaee the muscular activity so neeessary for the well-being of the body, and under these eireumstances are also called »Dietetie Gymnastics». It is also used by young people of weak development, who for some reason or the other cannot stand the educational gymnasties. A faet which is peculiar for Stockholm is well worthy of notice, viz. that five or six hundred poor patients are given the movement-eure gratis at our State institution.

The Swedish movement-cure has by degrees been acknowledged as an excellent therapeutie both at home and abroad. The Swedish gymnasts exercise their beneficial calling all over the civilized world, and the movement-cure has everywhere been called »Swedish Movements», when the intention is to show that it is really of intrinsie value and is based on a thorough scientific basis. It must, however, be confessed that the scientifie development of gymnastics has not kept paee with its otherwise rapid progress. As yet gymnastics as a science has only found Swedes undertaking new departures. As the greatest step in this direction, there is Dr G. Zander's ingenious invention of the mechanical method (see page 198) and Major Ture Brandt's introducing gymnastics in the treatment of uterine diseases. In time Swedish gymnastics will doubtless attain further development abroad, since at present foreign physicians, gymnastic teaehers, and army surgeons, numbering about 30 to 40, annually attend our gymnastic institute so as to study the different braneh es of gymnastics here.

Even in Ling's time aud that of his immediate successors, there were one or two foreigners who visited us for this purpose; but the real influx of foreigners eommenced at the close of the eighties, when Germany, Austria, Russia, and Ameriea had most representatives; while dating from 1890 Switzerland, France, and Italy have also sent their contingent.

The Scandinavian Gymnastie Instructors' Association meets in Stockholm onee a month from September to May, when lectures and discussions are held concerning all branches of gymnastics. Every second or third year, moreover, special meetings of gymnastie instructors are held either in Stockholm or some one of the country towns. The effect of this association as regards the work and further development of the gymnastie instruetors after their final examinations are

passed is most important. The organ of the association is »Tidskrift i Gymnastik» (The Gymnast's Journal), first published in 1874 by Professor T. J. Hartelius. This magazine tries to bring about the development of rational gymnastics in the entire compass of the science, and articles are accepted not only written in any of the Scandinavian languages, but also in English, French, or German.

Zander's Medico-Mechanical Gymnastics. This gymnastic method was founded in the beginning of the sixties by Dr. Gustaf Zander in Stockholm. It was based on Ling's doctrine that pathological changes in the organism can be removed by means of systematical exercises. Ling attained this object partly by the use of active movements of resistance, partly by passive treatments such as chopping, rubbing, kneading, etc. These movements were given by gymnasts trained for the purpose. Zander substituted gymnasts by mechanical apparatus, where the resistance required in active movements is represented by a moveable weight attached to a lever; while for passive movements he made use of the motor in a most ingenious and efficient way. He constructed chopping-, rubbing- and kneading-apparatus and also, greatly to the advantage of gymnastics, executed the vibratory operations more effectively. All these apparatus are so constructed that they allow of measured application and the strictest individualisation, and work in accordance with the physiological laws of movement. A complete institute has 71 different apparatus.

Particularly devoting himself to the treatment of curvatures of the spine, he has constructed a great number of orthopedic apparatus for their correction and, to make the diagnosis of these forms of disease possible, he has constructed a special trunk-measuring apparatus. Having worked for the same purpose as the manual method of medical gymnastics, though by different means, Zander has attained most brilliant results in the treatment of affections of the heart, of nervous complaints, and stomachic disorders, of diseases affecting muscles and articulations, and of curvatures of the spine.

In consequence of the large scale on which gymnastics can be carried on by the Zander method and also of its cheapness, it has in Germany attained great importance in the treatment of those disabled by accidents occurring in the course of their work. Convalescent Homes provided with Zander apparatus have been founded, where the most effective help is given to the workman for the purpose of restoring his efficiency as soon as possible. The Zander method has become of great importance also as dietetic and developing gymnastics.

In Stockholm there are at present two complete Institutes and a third with a partial equipment of Zander apparatus; at Gothenburg there is one complete Institute. There are partially equipped Institutes in the Swedish towns of Upsala, Örebro and Norrköping. — There are fully equipped Institutes at Kristiania, St. Petersburg, Baden-Baden, Hamburg, Berlin, Breslau, Mannheim, Frankfort-on-the Main, Dresden, Würzburg, Leipzic, Wildbad, Stuttgart, Wiesbaden, Aix-la-Chapelle, Ragatz, London, New York and Buenos Ayres, and a partial equipment of appa-

ratus at Åbo, Moscow, Copenhagen, Karlsruhe, Pforzheim, Nieder-Schönhausen, Munich, Elberfeld, Bochum, Königshütte, Chemnitz, Vienna, Buda-Pesth, Baltimore, St. Louis.

Dr. Zander has published several works on his gymnastic method, and amongst others a guide to mechanical gymnastic exercises which has passed through several editions: »Die Apparate für Mechanisch-Heilgymnastische Behandlung und deren Anwendung», and special treatises on the method have appeared in various periodicals. Dr. H. Nebel of Frankfort has published an extensive work on the Zander method, »Bewegungskuren mittelst Schwedischer Heilgymnastik und Massage mit besonderer Berücksichtigung der Mechanischen Behandlung des Dr. G. Zander». Full information concerning the method, as also a review of the literature on the subject is given in the work of Dr. A. Levertin, »Dr. G. Zanders Medico-Mechanische Heilgymnastik, ihre Methode, Bedeutung und Anwendung» etc., of which an English translation will soon be published.

The Zander gymnastic apparatus are manufactured exclusively by Göransson's Engineering Works Co. Lim., Stockholm.

Public Baths*.

During the past twenty-five years, bathing has greatly developed in Sweden — when the climatic conditions of the country and the fact of its being so sparsely populated is taken into consideration; — more especially in connection with the numerous health resorts and spas, of which at least fifty are provided with fully equipped bathing-establishments.

As regards the **Public Warm Baths** in the large towns of the kingdom, the following facts of social hygienic interest are gathered from a recent enquiry into the matter that has lately been published. In the capital, Stockholm, and 28 large, or tolerably large country towns with an aggregate population of about 700,000 souls, there are 46 Public Warm Baths provided with a total of 700 bath-tubs, besides arrangements for vapour-, hot-air, and shower-baths, etc., being an average of 1 establishment with 15 bath-tubs for every 15,000 inhabitants, or one bath-tub with appointments to each thousand persons of these communities. Stockholm, with 250,000 inhabitants, has 6 Public Baths with all in all 220 separate bath-tubs, besides about ten large bath-houses in public institutions and hospitals. As a general rule, the hospitals and asylums of the capital and larger country towns are provided with very well organized bathing-establishments, which, to a certain degree, are available for persons not connected with the institutions. In the beforementioned country towns, with altogether about 450,000 inhabitants, there are 34 bathing-establishments containing all in all 430 bath-tubs.

* By Professor C. Curman.

Most of the public warm baths are erected by companies, associations, or private personages and very few are established at the expense of the communes or receive grants. In the capital, the Stockholm Baths Co. took the initiative twenty-five years ago in opening such establishments on a grand scale. One of these baths may be regarded as a perfect pattern of an hygienic establishment, both as regards technicalities and complete comfort, and can provide 2,000 warm baths a day, and 300 separate baths at a time, of which the greater number are supplied at very low rates.

The larger baths in Sweden are generally provided with separate divisions for men and women, each of two or three classes with different fittings and charges; being provided with compartments for separate warm baths, as also graduated shower-baths, hot-air and vapour-baths; swimming baths and douches. The warm baths are generally taken in very large bathing-tubs, usually of wood painted, or of porcelain, of metal, or of cement-mosaic; the bathers being carefully scrubbed, lathered and kneaded by the bath-attendants of which each establishment has a large number. The Swedish hot-air bath is something between a Turco-Roman dry-air and a Russo-Finnish vapour-bath. Such a bath, consisting as it does in sudation, and a thorough lavation in a large Sudatorium of moderate heat and moisture, followed by a cooling process in a smaller plunge-bath, is a kind of national and very popular bath which has been found the most practical for us, is healthy, and may be procured at very slight cost. As regards the installation of exclusively cheap or *free* baths of any other kind there are almost insurmountable difficulties, since circumstances do not allow of the workmen bathing on any other evening except on Saturdays. Here in the north this so-called *»badstu» bath* is the most natural form of bathing for the populace during the winter. On this principle, of late years, several school-baths for children attending the National Schools have been arranged in many places and found to answer most satisfactorily. By these means during the short space of two hours — in a simple and inexpensive hot-room and a plunge-bath of tepid water — 200 children can take a wholesome and invigorating bath during the winter months. In many of the different National Schools of Stockholm there are similar arrangements, where every child may take a complete bath of this kind either each week or fortnight.

The use of warm baths has greatly increased of late years, and houses are now generally built with bath-rooms. In the public bathing-establishments of Stockholm and Gothenburg about 200 warm baths of all kinds per year are counted for each hundred inhabitants. The average frequency in other towns is only 75 baths per 100 inhabitants. Concerning the distribution of warm baths into different classes, in Stockholm and Gothenburg 22 to 25 per cent fall to the first class; 30 to 38 to the second; and 40 to 45 to the third class. As regards sex, only one fourth of the total number of the baths have been taken by females; a state of things which is however improving year by year. The country towns are

worst off as regards cheap warm baths, as according to accounts only 30 per cent fall to the so-called third-class or workmen's baths.

Although as a general rule an ordinary warm bath is that mostly taken, still Oriental and hot-air baths are daily gaining ground, more especially as cheap workmen's baths. This form of bathing is, in Stockholm, that of 75 per cent of all the third-class baths, and the garrison troops annually get 70,000 such baths, each man taking one weekly during the so-called winter season of six months. Compared to the number of bath-tubs, it has been proved that a thousand baths fall to each one per year, or three baths per day, which shows that the resources as regards taking warm baths are far greater than the demand. The attendance given from time immemorial by elderly women is more thorough in Sweden than any where else, there being generally one attendant to each bath-tub. Male bath-servants are also available at most of the large bathing-establishments.

In large towns the baths are open daily from early morning till 10 p. m. Saturday is, however, the favourite »tub-day» in the North, where the very Swedish name for Saturday signifies bathing or washing-day.

The *prices* for warm baths are on an average 24 cents for a first-class, 16 for a second-class, and from $5^1/_2$ to 8 cents for a third-class bath. In Stockholm the charges for a separate warm bath range from 34 down to 9 cents, this payment including douches, attendance, soap, towels, etc. A complete hot-air bath (Turco-Roman) with massage, etc. costs, first class, from 40 down to 27 cents; second class, 20 to 13 cents, and in so-called popular »badstu» 7 to $5^1/_2$ cents; soap and bathing towels included.

The monetary results, as a general rule, are not very favourable, the expenses as regards heating, maintenance, and attendants being rather high. The supply of water is obtained either from the ordinary water pipes (though usually only for payment in full) or from pumps belonging to the baths. The amount of water used per bath is relatively very large in Sweden, being on an average 600 to 700 litres (160 to 180 gallons) but usually a cubic metre (260 gallons); the price of the water being 15—20 öre per cubic metre (15—20 cents per thousand gallons). The coal used for heating the water and the premises is about $^1/_{10}$ of a hectolitre (20 lbs.) per bath. The expenses of erection, etc. calculated on the mean sum paid for ten large well-built establishments, each providing 100,000 baths a year, have amounted to $ 60,000 a piece, corresponding to an interest of 4 cents per bath. Two of these establishments have each cost about $ 130,000. The entire cost of a warm bath in these buildings has proved to be 18 cents.

A special peculiarity in Sweden are the **mud-baths**, which have been employed here for more than two hundred years. The method developed from that of Loka, which was known in the beginning of the eighteenth century. Differing from the custom abroad the mud in the baths here is used as a means of friction, it being rubbed into the skin, and the muscles kneaded and treated with massage.

On account of the large quantity of silicious infusoria the mud contains, it is a very powerful stimulating means of friction for the skin.

In the many lakes, rivers, and bays there are ample opportunities for **cold baths** during the summer months. The most frequented of our excellent seaside watering places are Strömstad, Lysekil, Marstrand and Varberg on the North Sea, while on the Baltic there are Borgholm, Visby, Norrtelge, etc. In all large communities swimming-baths of different sizes exist, generally spacious and well equipped — mostly at the expense of the communes — where workmen, children attending schools, and the poor may obtain a refreshing bath, either at greatly reduced rates or entirely gratis. The art of swimming is encouraged by competitions, usually in connection with the conferring of the so-called »master of natation» degree. The town of Stockholm has erected magnificent baths with numerous large and small floating swimming-baths where 300,000 to 400,000 dips are annually enjoyed; 150,000 of those being taken by scholars who at the same time receive instruction in natation, so that each child can obtain about 40 baths gratis. The poor pay but $1^1/_3$ cent for each bath taken at this establishment.

Cold water cures are gone through at the establishments at Bie, Söderköping, Hjo, Sköfde, Mösseberg a. o. Our Swedish spas and watering places are described in »Svenska brunnar oeh bad» by Dr. A. Levertin.

Hygiene of the workshop and factory, etc.

Sweden was one of the first countries, where legislation attended to the want of personal protection during labor. As early as 1720 the guild-statutes fixed that *non-adults* below 14 years were not to be employed in trade. For factories and mechanical labor the work of non-adults was regulated through law in 1846, when the age for their admission to such work was fixed at as early an age as 12 years. By this law employers were charged with certain duties regarding the instruction, health and morals of non-adults in their service, and in 1852 tradesmen were prohibited, under penalty of a fine, from employing non-adults at nightwork (between 9 p. m. and 5 a. m.).

In 1859 the Diet recommended that the daily time of labor be reduced, by law, to 8 hours for non-adults below 15 years employed in cigar-factories, spinning-mills, textile-factories and other branches of industry, and to 10 hours for other non-adults below 18. No law having relation to the regulation of the daily time of labor, appeared however, before 1881, the Diet already having in 1875 renewed its proposal to the Government in this matter and then with the addition that a committee of competent men should be formed to prepare a law regarding the engagement and employment in factory labor of children, and also the necessary State supervision as to the observance of that law.

According to the law of 1881, which is still in force regarding the employment of non-adults at factory-work, manual labor and other trades, children at 12 are permitted

to be received into craft- and factory-labor, if they have acquired the lowest standard-knowledge for leaving the National school. The time of labor for children up to 14 years is 6 hours, and for children from 14 to 18 years 10 hours a day, night-work, however, being prohibited for non-adults from 8 p. m. to 6 a. m. Iron-works, sawmills and some other factories are exempt from the two last mentioned stipulations. The observance of the law is to be controlled by communal authorities.

According to the proposition of a committee of 1891, the limits of age for admission as laborer into factory or industrial works was to be raised to 13 years, non-adults between 13 and 15 to work only 6 hours a day, older non-adults, at the most, 11 hours, night-work to be prohibited up to 18 years (21 years for women), and the supervision, regarding the observance of this law, to be under the control of government-officials (»trade's-inspectors»).

A proposition for a law regulating *employers' liability* to pay damages for injuries received by their employees during work has several times been discussed by the Diet, no solution of that question, however, having as yet been arrived at. Yet, to those who have been injured, when employed in railway-work, damages are guaranteed according to the law of 1886, the statutes of which favor those employed in railway-service more than others.

The present law in Sweden regarding *protection against dangers* incident to employees, has been in force since July 1890 under the supervision and control of 3 trade's-inspectors appointed by the Government. According to this law, the employer is bound to take all such precautions, as may be found necessary for the protection of life and health of laborers in his employment with regard as well to workshops, engines and tools, as to the general nature of the work. The adoption of any protective action demanded by the inspector, but not willingly acceded to by the employer, will, however, in each separate case, depend upon the consideration and decision of a superior authority. The principal aim and spirit of this law and of the instruction for the inspectors is to awaken the employers' interest in the introduction of such special protective measures as may be found necessary, to provide good sanitary conditions within the workshops, and to spread knowledge regarding the arrangements, precautions and provisions requisite for the above purpose.

The manufacture of *phosphorus matches,* which is carried on to such an extent in Sweden that about 2,000 laborers are employed in it, is in its nature especially injurious to health. Yet the difficulties in this respect have been materially reduced through the provisions put into effect by the law of 1870. This law stipulates that managers of factories for phosphorus matches shall have qualified in technical chemistry. The preparation of the fulminate, the dipping, drying and packing of the matches shall take place in separate and well ventilated rooms, paved with asphaltum or concrete and having walls oil-painted to a height of at least 3 m. (10 feet). There are special stipulations regarding careful and repeated cleanings of the workshops and their size. The preparation

of the fulminate and the dipping of the matches must take place only under safety-casings provided with effective ventilators, and those who are employed at this work are, after every 6 months of labor, entitled to at least 2 months' leave from this kind of labor, regarding which a special record is kept for every laborer at the factory. There are also directions for washing, cleaning of the mouth and change of working-dress before the meals, and medical examinations are to take place 4 times a year. Experience has proved that the state of health among these laborers has not called for any founded complaints in factories where these directions have been followed.

One of the principal branches of industry of the country, the *timber-trade,* is of a notoriously dangerous nature, and the saw-mills in Sweden employ, yearly, more than 24,000 laborers.

Next to the floating of the timber, the most frequent and most severe cases of injury connected with this trade occur in consequence of the handling of the lumber introduced in order to be squared by the circular saws especially adapted for this purpose. Accidents from this cause, however, have almost ceased in saw-mills provided with modern safety arrangements, besides which, the use of dynamos has considerably reduced the extent of transmissions and consequently also the number of accidents resulting from them.

Poor Law, etc.

Those persons entitled to maintenance from the public rates are, according to a Law of 1871, non-adults (below 15 years), and those who are incapable of obtaining their means of necessary support from labor on account of old age, physical or mental disease, infirmity or bodily injury, and who are destitute of property as well as of the care and support of others.

There are special stipulations regarding assistance for poor children of school-age and for those persons who have been released from convict labor or from prison, and regarding free nursing in hospital for poor people falling sick within the district of the hospital.

Public assistance may also be given under other conditions, according to regulations laid down by the *Board of Guardians* of the commune.

Maintenance from the public shall be given to those, who are in need, by the community, to which they properly belong. The relief can be either of a full or of a partial nature; that of the first kind is, in most cases, to be enjoyed either in special institutions for the relief of the poor, or by boarding out at the expense of the commune; the latter kind generally takes the form of relief to the poor in their own homes.

In 1890, the number of communal poor boards was 2,487 and of people enjoying relief 241,113, or 5 % of the whole population of the country. This average percentage was made up of one from rural districts of 4·4 % of the entire

population, and from urban centres one of 7·6 %. Of the whole number of individuals thus unavoidably dependent on the support of their neighbours, somewhat more tban ¼ received full relief, the remainder being in partial receipt of assistance. The total expenses for poor-relief amounted to about $ 2,780,000, or an average of 58 cents per head in the whole kingdom, 44 cents in the country and $ 1·18 in the towns. Equally divided among all who took relief, the expenditure on each of these was, for the whole kingdom, $ 11·62; for the country, $ 10·04; and for the towns, $ 15·48.

The board of guardians in the respective communes has the control of any one who is enjoying full support uninterruptedly, or who is receiving eomplete support for his wife or children. The board has thus the power of tasking him with labor, if he is able to work. This has long been the practice in the work-houses in towns. A step in the same direction, which has attracted much attention, is the establishment in the country of *poor-farms*, where the relief-takers are kept engaged either solely in farming, or in farming combined with other work. The poor-farms have proved to be a great blessing to the country, as well by their urging the poor to contribute to their own living, as by their reduction of the number of people claiming official relief and, lastly also, by their presenting facilities for a much larger number of actual imbeciles to obtain their living.

Childrens-homes and establishments for the rearing of children are institutions for the relief of the poor, the character of which is intimated by the above appellations. The Public Hospital for Infants in Stockholm is, with regard to its fitting up and general arrangements, one of the best establishments of this kind in the world. Even the public hospitals in general have to be counted among charitable institutions of the above mentioned class in as much as poor people are admitted there at the public expense.

With this care of the Swedish public for its distressed poor, *private charity* unites in a worthy manner. Many institutions founded throughout the country with a view of bringing help to orphan children, destitutes, aged and sick people bear witness of this. From charitable institutions, endowments etc. there is thus eontributed about $ 135,000 a year for the help of the poor and fully twice as mueh for the eare and education of infants. Several private societies and unions work in the same line, although an estimation of the extent of their operations is impossible. Among these none has, perhaps, won greater public sympathy than the »Charity Organization Society», which is founded in the Capital with a view of uniting such individual forces, as would, otherwise, too often act in the service of humanity unmethodically and without the necessary control over those who claim their assistance. The order of Freemasons support a large orphan asylum in Stoekholm. As institutions of a more casual nature may be counted the People's Kitehens, where, in times of scarcity of work, poor people are supplied with sound and substantial meals for nothing, or at a very low eost.

Public Health, Hospitals, Nursing, etc.

The superintendence of the entire medical administration with its subordinate institutions, civil and military, as well as the supervision of public health, vaccination, midwifery, surgery,[1] pharmacy, medical jurisprudence, the dental and veterinary professions, is incumbent on the *Royal Medical Board.*

The Governors, each in his province, shall see that the communes perform their duties as regards public health, which is under the immediate supervision of a Board of Health in each town, with subordinate sanitary officers and, in the country communes, of select vestries.

The civil medical attendance is discharged by *physicians*, who are either employed in the service of the Government or of the communes, or are engaged in private practice. Of physicians falling under the first of these categories there were, in 1890, practising in the country 216 and in the towns 134. Besides these, a number of physicians are also attached to the public hospitals, insane-asylums, railways and prisons. In every province one of the physicians, the *chief physician,* has the main supervision of the general hygiene within his district. In *military* medical service special physicians are appointed. — The aggregate course of study for medical students at a Swedish university extends over about 10 years.

The whole number of physicians amounted at the end of 1890 to 806, or one to 5,936 inhabitants. This proportion, however, varies considerably for different parts of the country. Most favored in this regard are, of course, such localities, where the medical schools are situated, f. i. Stockholm, where the proportion between the number of physicians and the number of inhabitants is as 1 : 1,500, and the provinces of Upsala and Malmöhus, whilst the ratio in several other provinces varies between 1 : 10,000 and 1 : 11,000. Another view of the relative supply of medical practitioners will be obtained, if regard is paid to the area of the zone falling to the care of each practising physician. This was for the whole country about 500 sq. km. (193 sq. miles), but amounted in the two northernmost provinces, where the population is scarce, to 5,473 and 3,831 sq. km. (2,113 and 1,479 sq. miles) respectively, whilst but 57 sq. km. (22 sq. miles) fell on each physician in the southernmost and most densely populated province.

For the nursing of the sick there were in 1890, in the whole country, 128 establishments with 7,173 *sick-beds,* or one bed to every 667th of the population, the Capital with 1 : 136 and the province of Jemtland with 1 : 1,932 presenting the extreme ratios. There are also 9 military hospitals and 12 lunatic asylums; the latter with 2,625 beds. To a large extent private charity has devoted itself to attendance on the sick, partly in special institutions and partly by founding free beds, and the formation of societies for the nursing of the sick in their homes, etc.

In 1890 the number of practising *dentists* in Sweden was 104. For qualification see page 213.

The number of *midwives* amounted in 1890 to 2,478, or one to 995 of the

whole female population of the country. They are generally engaged by the communes at a very small pay, or, as in the larger towns, referred exclusively to their private practice. There are 3 schools for their instruction. Out of the whole number of mothers in 1890 at least 75 % were attended at their confinement by midwives having passed the prescribed course of instruction.

All trade in drugs and medicine is by law restricted to the *apothecaries.* The number of apothecaries is limited; they must qualify for their profession, and no new chemist-shop can be opened without special permission. All such shops are subject to periodical inspections and must be examined once a year. There are also regulations relative to the sale of medicine, its preparation, the keeping of poison, etc. In 1890 the number of chemist-shops in the whole country was 259, or 1 to 18,475 of the whole population.

Notification of infectious or *contagious disease* devolves on the physician as regards patients attended for cholera, small-pox, typhus (typhus exantemathicus), typhoid fever (febris typhoides), scarlatina, diphtheria, and dysentery. The communes are bound to maintain hospitals, or other buildings for the isolation of the patients. In most towns there are now hospitals for the isolation of infectious diseases; in the country, however, they are as yet but rarely met. No person, on being attacked with one of the above-mentioned diseases, is exempt from removal to one of these special hospitals at the request of the Board of Health. Disinfection shall be undertaken in private houses after the patient, or body of person attacked with the infectious disease has been removed. Special carriages or stretchers are to be used for the transport of the sick persons. During epidemics, schools may be closed, fairs, assizes, etc., may be deferred, or inhibited, and large assemblies be forbidden.

A *quarantine* of 15 days is decreed against pestilence, when introduction of the contagion is feared; a special notice being then published each time by the Board of Trade. From places declared infected the import of certain articles such as rags, bedding, etc. is prohibited; while other articles arriving thence are to be disinfected. Vessels, arriving from countries where cholera rages, are simply ordered to lay up for observation for a time of 48 hours at certain places along the coast. A person attacked with cholera is isolated and the infected vessel disinfected.

As a protection for the country as regards infectious *cattle-diseases,* the import of ruminant animals from countries declared affected with cattle-disease (pestis bovina) is forbidden, as also of dogs from countries where rabies is prevalent. When animals are imported, they may be landed only in those towns where quarantine stables or sheds are erected, where, should it prove necessary, the animals may be isolated and be under observation for a certain time, differing according to the disease; while should a contagious cattle-disease break out in our own country, the farm, district, or entire province, is shut off from all communication with domestic animals, and the diseased animals are isolated or killed, according to the

description of disease, (sometimes those unattacked by the disease, but belonging to same flock, sharing the same fate). In the case last mentioned, the State, on certain conditions, refunds the owner of the cattle for his loss. Both the undiseased animals and cow-sheds are disinfected, before the prohibition as regards communication with other animals is removed. These precautions are under the supervision of a veterinary surgeon.

According to law, every infant in Sweden is to be *vaccinated* before it has arrived at the age of 2 years. Without a certificate of its having been vaccinated or of having had the small-pox no child is admitted into a common school. Vaccination is practised by licensed vaccinators, who obtain their vaccine from special depots superintended by physicians. In Stockholm there is a special institution for the production of animal vaccine and every case occurring of real cow-pox is, for this purpose, to be reported to the physician of the district. In order to promote vaccination zealous vaccinators are publicly rewarded.

The *control of all articles of food* falls to the Boards of Health for the towns, who for this purpose employ sanitary inspectors, who are to be admitted everywhere that food is kept, sold, or prepared for sale. In large towns there are, moreover, places where meat is examined so as to discover whether it contains trichinæ. Unsound articles of food are confiscated, or destroyed at the cost of the owner, either by being buried, or by petroleum being poured on them, or by being used in technical manufactories. Abattoirs do not exist here. The milk-shops are regulated by special by-laws which chiefly apply to the hygiene of the shops and preserving the milk from contagious matter. The Board of Health shall also see that the water drunk by the community is pure and free from taint.

Unhealthy habitations may be condemned, and public buildings, such as schools, theatres, works, etc, may be ordered to provide means of proper ventilation, should it be necessary. Offensive trades may not be established in large towns without the permission of the Board of Health, which has a right to prohibit the continuation of industrial pursuits which are found pernicious to the health of the neighbours. Cowhouses and mews may not be built adjacent to the street in towns; nor may their floors be other than impervious. Closets are to be on the »Pail» or Rochdale system and must also have impervious floors, lying higher than the surface of the ground. The night-soil and other house refuse, street refuse, etc., shall often be removed, and in the towns may not be allowed to accumulate.

Strong *poisons* are sold only from a chemist's or from technical works on receipt of a physician's prescription, or if for technical purposes, after special permission from the Governor of the province.

The Public Health Act of 1874, which does not contain so many details as the corresponding laws of most other countries, gives to the Boards of Health very extensive authority to take measures when and wherever nuisances occur, of whatever nature they may be.

For *Education* as regards National Schools, Peasant High Schools, Secondary instruction and Universities the reader is referred to page 25. In the following we shall treat the Technical Schools, Professional Schools, Schools for Abnormals, and Swedish Sloyd, beginning with the

Technical Schools*.

In Sweden the interests of Technical Education are promoted by means of many colleges of greater or lesser importance.

The Technical High School stands foremost in this work, and the noted Technical School of Stockholm holds a place of its own. For the training of engineers, but possessing, however, fewer resources than the High School, are Chalmer's Technical Institute in Gothenburg, and the four State Elementary Technical Schools in Malmö, Norrköping, Örebro and Borås. To these intermediate schools must be added the Technical Professional School at Eskilstuna and the State supported Lower Technical Professional Schools, 29 in number. There are, besides, the Sloyd Society's School in Gothenburg, and a newly established school in Luleå, which, until the present, have worked without Government support.

The *Technical High School* at Stockholm, the principal polytechnical institute in Sweden, has for its object the scientific training of young students, who intend to devote themselves to some technical occupation.

The subjects of instruction at this High School are: mathematics, geodesy, topography, descriptive geometry, elementary mechanics, higher theoretical mechanics, descriptive mechanics, construction of simple parts of machines, the theory and practice of machine construction, mining mechanics, the study of steam-ship construction, mechanical technology, general and applied physics, general and analytical chemistry, chemical technology, laboratory work, mining chemistry, general metallurgy, special metallurgy (of iron etc.), metallurgic laboratory work, mineralogy and geology, mining, building, building estimates, architecture, history of architecture, construction of roads and waterways, linear drawing, freehand drawing, ornament modelling, political economy and factory work.

The High School includes the following five technical departments viz. I. Machine Construction and Mechanical Technology, with partly a three years' and partly a four years' course; II. Technical Chemistry, with a three years' course; III. Metallurgy, in three sub-divisions, the first for mining mechanics, with a four years' course, the second for Metallurgy and Smelting, the third for Mining; the two latter divisions being courses of either three or four years; IV. Architecture with a course of four years; V. Road and Water-way construction, with equal courses of four years' duration. The course of instruction during the first year, is the same for all the ordinary pupils at the school, but afterwards the studies are directed according to the division intended to be pursued.

The Students at the High School are 1) Ordinary — who attend the teaching till they have acquired the amount of skill requisite to the obtaining, after a complete course, of a full certificate; 2) Special — who when they show themselves possessed of the skill required by the governors, enjoy instruction in a lesser number of

* By Rector V. Adler.

subjects, and may obtain certificates of their attainments in those branches; and 3) Extra-pupils — who need not give any previous proof of their ability by passing an entrance examination, and who may enjoy the instruction, but are not entitled to receive any testimonial from the college as to their attainments. For ordinary students the instruction is free; special and extra pupils pay a fee, fixed by the governors, and varying between 10 kr. and 50 kr. ($ 2·68—13·40) per term. The management of the High School is under the direction of governors appointed by the King.

The High School has, moreover, a library of about 23,000 vols. and above 500 manuscript reports of technical matters furnished by travelling students, and owns in addition a valuable collection of models, instruments etc. used at lectures on the various branches of study.

The Technical School in Stockholm has for its aim to give a clear and practical training in the knowledge which is requisite for an intelligent and accurate execution of industrial work, and by this means to further Swedish handicrafts and the development and improvement of art industry. The departments are five in number viz: — 1) The Technical Evening and Sunday School, intended for young pupils (above 14) and men, more particularly those who are already engaged in factories and handicrafts. The pupils are free in their choice of subjects and the scheme of study is so arranged that the students have a selection from 18 branches of industrial education. — 2) The Technical School for Women (students above 14 years of age) gives instruction in the intelligent and artistic insight and skill, which are the bases of that technical employment which can be most profitably pursued by women. The subjects of instruction are 9 in number and are at the students' choice. — 3) The Higher Art Industrial School has both men and women students (above 16 years of age), and the 3 years' course of instruction demands the whole or the greater part of the school day during the term. In the *first* section of this school is taught pattern drawing (both for cabinet making, and artistic metal working etc.); in the *second*, decorative painting, laequer work etc.; in the *third*, modelling, ornament, etc.; in the *fourth*, wood carving, chasing, engraving and work in the finer metals; and in the *fifth* section are trained the future teachers of drawing, modelling, and handwriting in the Schools for Secondary instruction, Technical Elementary Schools, and Normal Colleges for Teachers. — 4) The School of Building, with a course of 3 full years and an obligatory scheme of instruction, gives a training in the knowledge requisite for the strict accuracy demanded in the preparation of building plans; it receives pupils above 16 years of age. — 5) The School for Machine Work (founded 1890) gives that instruction required for the extremely accurate knowledge demanded by mechanical technical work, and, as does the previous department, receives pupils who are above 16 years of age. The *first* section is for the training of chief engineers, machinists and draughtsmen in mechanical work-shops; in the *second*, foremen of mills receive instruction; the *third* deals with assistant engineers and machinists, workers of metal plate for

steam boilers, smiths, makers of mechanical instruments, makers of clocks and watches etc.; in the *fourth*, shipbuilders receive their training; the *fifth* gives instruction to metal-plate workers for house, bridge and railway construction, and to constructors of water and gas systems etc.; the *sixth*, to founders, and the *seventh* is for the training of electro-machinists. — Besides these ordinary departments, there is an additional *day school* giving daily instruction in professional and decorative painting.

The ordinary subjects of instruction at the Technical School are: geometrical construction, linear drawing, descriptive geometry, perspective and freehand drawing, industrial-art designs, figure and landscape drawing, painting (after ornamental and detached objects, bas-reliefs, drapery, plants, animals etc.), modelling (from ornaments and figures), arithmetic, algebra, geometry, mechanics, together with practical mechanics, mechanical drawing and mechanical technology, experimental physics, chemistry and chemical technology, knowledge of commercial objects, instruction in tools, building construction, architecture and design, elements of field surveying and levelling, composition, book-keeping, ornamental writing, together with caligraphy, advanced industrial-art designs, wood carving, embossing, chasing, engraving, making of plaster casts, elementary history of art, estimates and (since 1887) special designs and applications for embossed leather work and painting on porcelain and glass. — Of no small importance is the instruction in the extraordinary subjects of training, for which school a special Government grant of $ 1,070 is received. The subjects taught include knowledge of styles and ornamental design, decorative and professional painting, art needlework, photography, hygiene of dwelling houses and workshops, and gymnastics.

The lecture rooms contain valuable collections of such models and engravings as are of illustrative importance in the instruction. The library numbers 10,000 volumes, mostly technical literature, and a well arranged collection of more than 18,000 design-engravings. The school museum embraces many thousand models, consisting in great part of plaster casts and metal castings from famous monumental constructions; a collection of copies of Italian decorative paintings, models for wood carving, fine metal work, art textiles, etc., a technical collection of dye stuffs, metals, weaving material, all the kinds of wood usually employed in various branches of carpentry, etc.

Chalmer's Technical Institute in Gothenburg is for the training of such young students as are intended for those industrial professions, whose pursuit demands a knowledge of natural science, and especially an acquaintance with technical chemistry; the institute gives such teaching in a higher and in a lower division. The higher division, which has a scientifical technical direction, embraces three classes of a one year's course and then divides, after the first year's training, into four different sections, viz. the mechanical-technical, that for technical chemistry, the section for construction of roads, waterways, and buildings, and, finally, that for shipbuilding. The lower division, in which the teaching is of a general comprehensive character, and particularly in practical directions, embraces two one-year's classes.

There are besides in Sweden, four *Technical Elementary Schools:* in Malmö, (founded 1853), in Norrköping, Örebro and Borås. They have as their object, the imparting of elementary technical knowledge to young pupils who wish to fit themselves for industrial occupations. The subjects taught are: mathematics, mechanics, physics, chemistry, mineralogy and geognosy, the Swedish language, the

principal modern languages (at choice), commercial book-keeping, architecture, freehand drawing, modelling, and factory work.

The Technical School in Eskilstuna consists of two departments. — The older of these, the Sunday and Evening School, is intended for the instruction in the most necessary elementary technical knowledge, of such persons who are already engaged in industrial pursuits, especially in the iron and steel manufacture. The subjects of instruction (all optional) are mathematics, descriptive geometry, linear drawing, general mechanics, mechanical technology, practical mechanics, machine drawing, physics, chemistry, freehand drawing, modelling, professional drawing, good handwriting, the Swedish language and book-keeping. The instruction is given in a higher and in a lower course, both of two years. The Sunday and Evening School is in yearly receipt of a grant of $ 2,144. — The second department is for instruction in finer smith's and metal work; it receives (since 1889) a yearly grant of $ 402 from the town of Eskilstuna, and an annual grant from Government of $ 1,072. The subjects are freehand drawing, modelling, wood carving, engraving in metal, metal casting, chasing, embossing, etching, galvanizing, smithing, filing, turning, professional writing, and knowledge of styles.

In 1892, there were 29 *Lower Technical Work Schools*, erected by various large towns, and principally intended to give young people, engaged in handicrafts and manufactures, a necessary instruction in their native language, good writing, arithmetic, freehand drawing, linear drawing, professional drawings, modelling, and various forms of instruction in professional painting, building design, machine and building drawing.

The number of teachers and pupils at the Technical Schools, during the spring term 1892, and the amount of Government and communal grant in the same year will be shown by the following table.

Schools.	Grant for 1892. Dollars.		Pupils.		Teachers.
	Government.	Communal.	Men.	Women.	
Technical High School, Stockholm ..	39,316	——	272	——	26
Chalmer'sTechn. Institute,Gothenburg	10,666	——	212	——	13
Technical School, Stockholm	25,212	2,010	981	451	70
4 Technical Elementary Schools.....	25,406	* 134	240	——	38
Technical School at Eskilstuna	3,216	402	155	4	11
29 Technical Professional Schools ...	9,326	17,500	2,915	851	201
Total	113,142	20,046	4,775	1,306	359

* Besides free locale.

Besides the above mentioned grants, the Schools disposed of donated funds as follows: Technical High School $ 33,500, Chalmer's Technical Institute $ 93,800 Technical School at Stockholm $ 16,884, Technical School at Eskilstuna $ 7,370.

Professional Schools.

The greater number of these schools have already been touched on when speaking of those special callings in which instruction is imparted; the High and other Schools of Agriculture being mentioned on page 47; those of Dairy-farming on page 54; the Veterinary Institute on page 78; instruction in Gardening on page 76; the Forest Colleges page 72; instruction in Mining page 127; schools of Navigation page 154; and the Technical Schools page 209.

At the *Royal Academy of Fine Arts* in Stockholm there is a school of art and design, mentioned on page 230, and at the *Royal Academy of Music* a conservatory as stated on the same page.

As regards other professional schools, which are not already spoken of in this work, the following epitome may be given.

Military training and educational establishments in addition to the Royal Military Academy (vide page 230) are:

a) The Staff-college in Stockholm, with a two-years' course (in 1892 there were 38 pupils) and chiefly designed to train Staff-officers;

b) The High School of the Royal Artillery and Engineers (51 pupils), also in Stockholm, where officers of the Artillery and Royal Engineers receive instruction;

c) The Military College at Karlberg, in the vicinity of Stockholm (56 pupils took their final examinations in 1892) is an educational establishment for young men intending to become officers in the army;

d) The Military Riding School at Strömsholm; schools for corporals, cadets, non-commissioned officers, preparatory schools of same kind; a Gunnery School, etc.

In respect to the *Navy*, there is a Royal Naval School in Stockholm for training officers for the Navy; the number of pupils in 1892 being 73.

For a right of practising as a *dentist* in Sweden it is neccessary not only to have passed the so-called student's examination but also two special examinations, the latter in presence of examiners appointed by the Royal Medical Board. The time generally taken for these studies is calculated as about three years, and there are dental colleges in Stockholm and Gothenburg.

The *Pharmaceutic Institute* in Stockholm aims at imparting that knowledge necessary for practising pharmacy properly; the number of pupils being usually about 70.

Mercantile Instruction is imparted not only at two more extensive colleges — one in Stockholm, the other in Gothenburg — which may be said to be real commercial schools, but also at a great number of private mercantile schools kept by private individuals. The two colleges, with courses of two years' duration and which together teach more than 100 pupils, receive grants from the public purse, but are chiefly dependent on donations, as also on fees paid by the pupils.

Schools for Abnormals.

Children who are *deaf-mutes* have until quite recently been received from all parts of the kingdom at the large public institute for deaf-mutes called Manilla, in Stockholm, which was founded as early as 1809 by P. A. Borg, and where by far the greater number of the children admitted have been educated gratis. By a law dated May 31st 1889, the education of deaf-mutes of school-age is made compulsory and, at the same time, the kingdom has been divided into seven districts, each being responsible for the education of the deaf and dumb children belonging thereto. When in time this organization is thoroughly established, the Manilla Institute will probably be simply for that district in which it lies, though the training college for the teachers of deaf-mutes of the entire kingdom will still continue to be at this institute.

The State grants $ 53,600 a year for the education of deaf-mutes. There are three asylums for full-grown deaf-mutes, being situated respectively in Vadstena, Bollnäs, and Skara. The total number of deaf-mutes in Sweden, on taking the census in 1890, was 5,307, of whom 2,952 were males and 2,355 females.

The *Blind* receive instruction at the new and magnificent Royal Institute for the Blind at Tomteboda, in the vicinity of Stockholm, as also at a couple of smaller institutes receiving support from Government. The institute just mentioned receives an annual grant of $ 13,500, and during the past year imparted instruction to 76 pupils. The two smaller asylums during the year 1891 received a grant of about $ 3,000. Besides these sums $ 700 were granted for the printing of reading-matter for the blind during the same year, as also $ 300 for the support of pupil-teachers. In Sweden, in 1890, the blind numbered 3,948, the males being 1,880 and the females 2,068.

In Skara there is an asylum for the education of children who are both blind and deaf-mute; the number of pupils during the past year having been 11.

For the education of *idiots* in their school-age there are a goodly number of asylums, there being 16 educational establishments with altogether 432 places; 6 industrial homes, that house 84 pupils; and 8 asylums affording places for 106 children; besides a number of private asylums destined for the care or education of those of weak intellect. At the Idiot School in Stockholm there is a training college for female teachers and nurses. The total number of idiots in their school-age is calculated as somewhat more than 2,000, according to an investigation made a few years ago.

Swedish Sloyd*.

Sweden has occupied an important position in a movement, which during the past twenty years has made manual labor a factor in all rational education,

* By O. Salomon, Director of the Sloyd Seminary at Nääs.

a movement, directed against the old fashioned one-sided system of mental overwork. The great interest, which a number of private individuals, teachers, clergymen, physicians, merchants and land-owners have shown in this work, has led to the introduction of the sloyd in the Swedish schools. An educational system was arranged, which has since been followed in many countries of Europe and America.

In the early seventies, definite steps were taken to teach sloyd in the existing schools and likewise to open special schools for this purpose. Private individuals were the first to support the work and were afterwards aided by the municipal authorities, the Provincial councils and various Agricultural Societies. The subsidy from the State was indirectly given, since the Royal Academy of Agriculture distributed $ 5,400 per annum for the sloyd instruction.

In 1877, the Diet voted $ 4,000 per annum to advance sloyd instruction for boys, there being at that time some 80 schools where this subject was being taught. Each school received $ 20 per annum. The following figures will show the number of schools, which each year have received the benefit of the State stipendium.

Year.	Number of schools.	Year.	Number of schools.
1878	103	1885	727
1879	163	1886	872
1880	234	1887	991
1881	300	1888	1,167
1882	377	1889	1,278
1883	463	1890	1,392
1884	584	1891	1,492

In 1891 the State paid $ 30,000 for this purpose, besides which large sums have been contributed by the Provincial councils, Agricultural societies and parish authorities.

As there are many schools, which do not come under the Government benefit, we find that, at the present time, some 1,800 schools enjoy the privilege of sloyd instruction. In only a few schools is this work obligatory, but it is encouraged by inspectors of the public schools and also by specially appointed examiners. Nor is a particular system in detail enforced. The »Swedish sloyd system» refers to the one, which has been worked out by means of the combined efforts of many Swedish teachers and is taught at the Sloyd Seminary at Nääs, where many of our teachers have learned the work. The sloyd has likewise been taught at four Public normal colleges for males and will now be introduced in all. In several of the provines, sloyd courses have been arranged by the authorities for the benefit of the public school teachers. A sloyd instructor usually appointed by the State teaches the subject.

The *Nääs Normal College* is a private institution. It was founded and is maintained through the munificence of August Abrahamson, the proprietor of the Nääs estate, situated some 30 kilometres from Gothenburg. It was first

opened in 1874 as a graduate department of the sloyd school for boys, which had been founded at Nääs two years before. Until 1882, only special teachers of sloyd were admitted to the training college. Since 1878 besides the yearly course intended for this purpose, shorter courses were arranged, so that teachers of other schools could obtain instruction in educational sloyd. At the present time, the courses are of six weeks duration, there being four courses per annum and this year 270 students. About one fourth of this number are students, who participate in two or more courses at the seminary. The instruction is gratis. It consists of lectures and discussions concerning the method, system and history of educational sloyd and also the making of a series of models in wood, which have been arranged according to certain definite exercises.

During the summer courses, many foreign teachers have attended at Nääs. From 1875 to 1892, there have been 1,808 teachers on the rolls, not including those who have taken a second course. Of this number, 1,383 were Swedes, 44 Norwegians, 27 Danes, 1 from Iceland, 23 from the United States, 1 from Canada, 2 from Uruguay, 1 from the Argentine Republic, 1 from Brazil, 1 from Chili, 155 from England and Wales, 17 from Scotland, 2 from Ireland, 44 from Finland, 28 from Holland, 20 from Russia, 16 from Italy, 14 from Austria, 12 from Germany, 7 from Hungary, 3 from France, 3 from Belgium, 1 from Switzerland, 1 from Spain, 2 from Japan, and 1 from Abyssinia.

Educational sloyd has not the purely economical object of the house-sloyd. The former becomes a factor in the training of the youth, in so far as it lays stress not upon the direct increase of income to be derived from the work, but rather upon the benefit to accrue to the mind and character of the individual. The bettering of the individuality, or, so to speak, this preparation for the duties of life, may consist in either the acquisition of a certain definite knowledge, the future use of which is to prove of useful value, or in the development of certain qualities, which tend to make the individual better fitted for his mission as a man and a citizen. According as the instruction proceeds from the one or the other point of view, it becomes either a special or an elementary instruction.

Pedagogical sloyd demands its position in the elementary school as a factor in general education, and has as its chief object not so much the teaching of technical skill as the development of certain powers, physical, moral and mental, which make a man, whatever his social standing may be, more thoroughly and harmoniously organized. It affects the individual by increasing his love for work, for independence and by strengthening his physical powers. It will teach precision, cleanliness, orderliness and attention. It will accustom to perseverance and to the value of manual labor. It will educate the eye to see and the hand to make. These and similar aims are the reason why sloyd is a formal means of education and training, and therefore it is that qualifications other than those possessed by the ordinary mechanic are essential requisites for a sloyd-teacher. To teach sloyd, one must not only have knowledge and technical skill but also the power of

training and educating. The workshop of the mechanic and the school for the teacher have formed a common basis on which Swedish educational sloyd rests.

House-sloyd looks principally to the pupil's time being occupied and rather upon what he makes than how he makes it.

Educational sloyd has for its motto »Quality not Quantity» and applies this to what the instruction embraces and the manner of execution. It has brought about a concentration upon one particular kind of work and instead of teaching several branches, it confines itself to one kind of sloyd, viz. sloyd-carpentry. Throughout Sweden, the sloyd has been adopted most especially for children of the age of 10 to 14 years and therefore the instruction at Nääs has been limited to the sloyd-carpentry intended for pupils of that age. In some of the Swedish Public schools instruction is likewise given in paper and metal-sloyd, wood-turning and wood-carving.

Sloyd is something other than a trade. Sloyd carpentry is not the trade of the carpenter. The carpenter usually produces large articles limited chiefly by flat and cylindrical surfaces. Sloyd makes small objects or models, the surfaces of which proceed in many directions. This so-called »form-work» offers much opportunity for the development of the eye. It becomes in reality a modelling in wood, which like that in clay or wax is an excellent complement to free-hand drawing. The tools in the sloyd and those in carpentry differ somewhat. In the sloyd, among others, the knife, the axe, the spoke-shave and the spoon iron are used — which carpentry does not. The knife is especially characteristic of the sloyd. What the chisel is to the carpenter, the knife is to the sloyder. It has been termed the fundamental tool and is the first tool to be placed in the child's hand, not only because it is the most common of all ordinary tools in daily use, but while it does not belong to any particular trade, it yet offers the means of acquiring the greatest possible general handiness.

The object of using physical labor as a means in education is that under certain conditions physical strength will result. It becomes therefore of the utmost importance, when nearly the entire body is to be in motion, to understand what positions and movements the nature of the work requires. There can be no doubt that the sloyd-carpentry takes precedence over other kinds of physical work in that it allows of and necessitates exercises and movements, which are of direct and indirect service to bodily development, although it can never be a substitute for gymnastics, at least not for such gymnastics, as are founded upon a rational and physiological basis. Gymnastics may be arranged having but one main object, namely the acquisition of health, whereas the sloyd has many pedagogical problems to solve and is held in check by these, as well as by the tools that are used and the material to be worked upon. Sloyd must unite itself with gymnastics, in considering the most advantageous positions to be assumed, such as will lead to the highest physical development. Specialists in Swedish gymnastics and in Swedish sloyd have aided one another materially in laying down what the best positions

and best movements should be for the exercises occuring in the sloyd-carpentry. The old maxim »A place for everything, and everything in its place» applies to the relationship between gymnastics and the sloyd. To insure a harmonious development of both sides of the body, the pupil is made to use the tools alternately with the right and left hand, thus exercising the muscles of each side of the body about equally.

Another aim of the sloyd and one of great importance is, that the work must be done thoroughly and with great care — this is but natural, since the sloyd is to serve pedagogical purposes. If, from the beginning, the work is done quickly but carelessly, it becomes almost impossible to get the child into the proper way of doing the work, whereas if the work is begun slowly but is well executed, by degrees as the skill increases, it will be done more quickly without deficiency resulting. The teacher must avoid not alone Scylla, to demand too much, but even Carybdis, to require too little, and, following the happy medium, must instil »Whatever is worth doing at all, is worth doing well».

The child must learn not only to work with exactness, but also with independence in reflection and execution. Educational sloyd desires to develop self-action, so that the child by its own observation and through its own power of reflection may acquire a clear idea of what is to be done and how it is to be brought about. By allowing practice to precede theory, by making action and execution form the basis from which the truly clear ideas may be developed, the natural sequence of learning is adhered to and the child is taught to think out its own thoughts, while working at its own work. The teacher must not use his own hands in doing any part of the child's work. »Hands off» must be impressed upon the minds of all teachers, who wish to make the sloyd, what without doubt it can be, namely a valuable means for the development of self-reliance.

It is not only with gymnastics but also with drawing, that the sloyd must go hand in hand. The latter supports and perfects the sloyd. When the necessary elements of drawing have been learnt, the pupils are permitted to apply these by making sketches of the sloyd-models; and also in executing the work, quite a good deal of free hand drawing is required in making outlines and constructions.

These points of view with many others form the ground-work of the Swedish sloyd. How they are to be practically applied will depend largely upon the personal influence and character of the teacher; also upon his manner of teaching or as it may be called, the method of educational sloyd. This method, like all pedagogically arranged ones, adopts the principle, that from a sufficiently easy commencement, the instruction is to proceed without any leaps or gaps to the more difficult, from the simple to the more complex, from the concrete to the abstract and from the known to the unknown. This methodical arrangement has been based upon what we call »exercises». By the term »exercises» is meant, the working of the material with one or more tools in a certain way with a distinct purpose in view. It is quite evident, that an almost unlimited number of exercises, or modifications thereof,

exist in such work as sloyd and that it is a matter of judgement to select the characteristic ones or type of exercises, which should form the basis of the methodical arrangement of this subject. The Nääs series contains 88 exercises, some simple, others complex. The method completes its pedagogic idea only, when the pupil while making useful objects is thereby enabled to acquire a knowledge of the exercises belonging to them and also to obtain mechanical skill in performing these exercises.

As to the models themselves, it is necessary, that they combine practical utility and aesthetic form. The child should make such objects as are useful in the home, thus strengthening the bond between the school and the home life. Articles of luxury, by which ornamental work is not referred to, are to be excluded.

The natural development of the individual being the chief aim, all artificial competition should be discouraged as experience has proved, that complete equality cannot exist in a sloyd-class.

Such are the most important principles of the Swedish sloyd and the Nääs system, but as before mentioned the latter is not followed in all Swedish schools, where similar work is taught. The fundamental principles of education are international. They belong to all mankind, for which reason, the Swedish sloyd has gained admission in many countries of Europe and America and as time goes on, the movement to introduce this work in the public schools obtains more and more advocates.

Libraries and Press.

The **Public Libraries** of Sweden, dating from 1886, have under the auspices of the Royal Library in Stockholm, annually issued a Catalogue of Accessions containing those foreign works bought, or acquired, by the Royal Library in Stockholm, the libraries of the universities of Upsala and Lund, of the High School in Gothenburg, as also those of the following institutions: the Academy of Sciences, the Academy of Literature, History and Antiquities, the Academy of Fine Arts, the Academy of Agriculture, the Carolian Medico-Chirurgical Institute, the Swedish Society of Physicians, the Technical High School, the Stockholm Technical School, the Central Bureau of Statistics, the Diet and the Staff General, together with a few special associations receiving public grants, and the libraries belonging to the Students and Society of Sciences in Upsala. This catalogue of the foreign acquisitions — the vernacular literature, according to Swedish Copyright Law, must be sent to the first three libraries mentioned, and are entered in a special »Annual Catalogue» — has caused a very extensive mutual accommodation, so that the various libraries borrow of each other; and from their own premises, or town, lend books which belong to some of the other libraries. This co-operation has greatly enhanced the accessibility of the libraries.

First in rank, both as regards appointments, grants, and number of vol-

umes, stands the *Royal Library* in Stockholm, which since 1878 is housed in a new building erected at a cost of close upon $ 270,000. The volumes number 230,000, besides 7,800 manuscripts, many thousand portfolios containing maps, engravings, smaller prints, etc. The accession of 1892 was 1,194 foreign works, while in the same year 13,162 issued from the Swedish press. The libraries of the *universities* of Upsala (about 220,000 volumes) and Lund (about 130,000) have also of late years been granted more extensive premises, and have larger reading-rooms and increased grants for purchases. The Academy of Seiences owns about 50,000 volumes; the other libraries being all of less extent. Among older and more valuable libraries, though at present without noticeable increase, or accessibility, we must not omit to mention the *School Libraries* in Strengnäs, Vesterås, Skara, Linköping, and Vexjö (the old episcopal towns). At other colleges there are less important collections of books. The *Popular* and *Parish Libraries* are developing rapidly, both in the capital and in a great number of parishes in the country. — *Private* libraries with family archives, often of a very respectable age, are to be found in several provinces, even if, during the past decades, not a few of them have been dispersed, while hardly a single private library of any importance has been founded during the same period.

The Press. The number of periodicals, newspapers, and magazines published in 1891 was 606, and during the same year more than 60 million papers were transmitted by post. This figure is, however, far from representing the entire number in circulation, since it is only exceptionally that the Post-Office undertakes the distribution of papers in the place where they are issued. The official Gazette of Sweden »Post- och Inrikes Tidningar» has this year (1893) had its 249th anniversary, and is consequently one of the oldest in the world. Several of the Swedish dailies, as regards size and contents, may be considered as highly satisfactory, while both price and cost of advertizing are unusually low.

Sweden, previous to any other country, fixed the principle of the *Liberty of the Press* by making it a part of the Constitution in 1766. To this day, no alteration whatsoever can be made in the original law concerning the Liberty of the Press, except with those formulæ decreed for the alteration of the Constitution i. e. the assent of two separate Diets, a general election having taken place between the first and second passing of the act. The Press-Law now in force dates from July 16th 1812.

Photography.

The great inventions in the art of photography, and the enormous, and speedy progress that it has made during the last ten years have, also in Sweden, exercised a remarkable influence in many branches. Within the range of »reproductive art», photography has produced a complete revolution. In this manner the publication of the survey maps of Sweden, published by the Topo-

graphic division of the Staff has been highly accelerated through the use of *photo-galvanography*, which was introduced instead of the expensive and slow method of engraving by hand. A great part of Northern Sweden has also been mapped out within the comparatively short space of 8 years in a manner, which it would have been impossible to attain without the help of photography. The same process has been made use of to advantage in the reproduction of fine scientific work, and of engravings, etchings, etc., of which simple copies only hitherto have been in existence.

We will now look at photography from another point of view — that of illustration. Particularly in *line-photo-engraving*, the cheapest and most common, Sweden is certainly not inferior to other countries, and it must not be omitted that in *tone-photo-engraving*, or the art of stereotyping directly from nature on pictures in half tone, Sweden has justly won great praise everywhere, not least at the Vienna Exhibitions, in which place this branch of art is highly developed.

The production, by means of photography, of printing plates (clichés for printing) in various colours, which has long met with difficulties on account of the expense, has been used of late in several illustrated works. The process of Collotyping (Albertypy), which reproduces pictures in half tone, has come greatly into use in our country. Our National Museum now furnishes its catalogues with reproductions in collotype pictures by eminent artists. Drawings by the hands of the old masters are multiplied by these means; papers, periodicals and books are provided with art supplements in phototype; from our annual art exhibitions we bring home beautifully illustrated catalogues as an artistic and lasting remembrance; in the shops we see reproductions of the works of painters and sculptors, views of our towns and beautiful scenery, and our manufacturers do not neglect to supply us with illustrated price-lists of their various articles. The photographic etching on copper, doubtlessly the prettiest and most artistic way of obtaining printing plates (clichés) by means of photography, has hitherto, on account of its expense, been less in use in our country than it deserves from its fine method; still, good examples have been produced during the last few years.

Lithography has found a wonderfully good ally in photography. At many of our lithographic institutions the so called photo-lithography is used to reproduce machine and other drawings, etchings, maps, etc. For this purpose pigment paper is used and is chiefly manufactured in the country.

When daylight during the winter months is not sufficient for photographic purposes or whenever a long exposure is required for the plates, electrical light is used. The same power is also used for the precipitation of copper plates from the photographically made relief figures.

As a means of education, photography takes a prominent position. Lectures in schools as well as to associations, clubs and societies gain an increased interest through the exhibition of magnified photographic pictures, produced by means of

a scioptic, or magic lantern. In several of our Technical schools photography is taught and its study practically illustrated by experiments both indoors and out.

For military purposes attempts are at present being made to turn the so called photogrammetry to account for the purpose of mapping fortifications, plans of fortresses etc., and so to obtain the ground plans by means of photography; selected officers are specially engaged in the study of photography, and at present the photographic apparatus is a part of the field equipage.

One branch of the photographic operations, which attracts us most, is the Tourist- and Amateur-Photography, in the study of which many have achieved a high standard of success, while the beautiful scenery of Sweden may be said to offer a fine field for the subject. For instantaneous photography we have a great many good subjects such as sailing and rowing races in the summer, skating, snow-shoe and other winter tournaments. During the light season of the year the actual time for exposure has really been reduced to $^1/_{100}$ of a second.

The interest with which photography is embraced has found expression in the forming of clubs and societies, which through lectures, experiments and discussions are endeavouring to develop photographic art. The most influential of these societies is the »Photographers' Club» of Stockholm, which has about 150 members, who meet once a month to discuss photographic questions and arrange for their annual exhibitions of photographs. Besides this, the club tries by the circulation of pamphlets, reproductions, etc., and also through public lectures to deepen the interest in the art of photography.

Lastly we must say a few words on portrait photography, the oldest branch of the profession, and in which are the greatest requirements in artistic taste as well as in technical execution. Special schools of photography are established, and it is by no means seldom that pupils are selected from those to go to the Academy of Fine Arts in order to develop their talent. In our larger towns we come across elegantly fitted ateliers, where all the latest photographical inventions are in use. We ought particulary to mention the enlargements on nitroglycol-paper, which, when coloured, leave very little to be desired. The cost of the magnifying apparatus, the so called solar camera, used for this paper, is about $ 400. Among portrait photographs we ought particularly to point out the great collection of Swedish national costumes, which are coloured and made by Gösta Florman. These photographs have justly been much admired by foreigners.

The annual importation of photographic apparatus and requirements amounts to about $ 130,000. The yearly sale of photographs made in the country amounts in value to close upon $ 1 million, and finally it is estimated that nearly 2,500 people are engaged exclusively in the photographic trade.

Civil Engineering.

Civil Engineering. For the construction of public buildings and for their keeping in repair there are in Sweden two principal institutions.

The Royal Board of Public Buildings has to draw plans and make out estimates of buildings projected for the Government, to assist public authorities and communities with advices and explanations and also to examine the plans of public buildings to be erected and, if necessary, to draw new ones; to have the supervision of houses and buildings belonging to the Government and to perform similar architectural work.

The Royal Board for Road- and Water-works, attends to technical and administrative concerns relating construction and improvements of canals, sluices, roads and other means of communication by land and water, harbour-structures, and dredgings, clearing of waters, and to works for the promotion of great agricultural enterprises by means of draining marshy places and lakes. This board also controls such works as are performed by companies, public authorities or private individuals and assisted with public money. With regard to the management of public roads and canals, and to the supervision of appendant buildings, the country is divided into six districts, each under its own chief with his assistants.

These officials are, as well as the Chief of the Board, also commissioned officers of a special Military Corps of Constructors of Roads and Water-works, and are liable as such to serve in case of war, as auxiliary-officers in the Corps of Royal Engineers. When not engaged on Government work, they are allowed to occupy themselves in the construction of private railways, harbour-work and bridges, draining-works, water-works in towns etc. This corps consists at present of 2 colonels, 9 majors, 33 captains and 22 lieutenants.

During the fifty years 1841—90, the following works have been accomplished with the assistance from the Government in form of free grants or loans.

	Grants.	Loans.
Roads, new or improved, 8,160 km. (5,067 miles)	$ 3,413,000	—
Private railways	1,059,000	15,289,000
Draining of land, 314,600 hectares (777,000 acres)	679,000	2,820,000
Clearance of watercourses	295,000	73,000
Building and maintenance of bridges.....	539,000	62,000
» of canals	675,000	570,000
» of harbours and similar works	845,000	706,000

The total sums afforded by the Government to these and similar enterprises during the whole period of fifty years amount in free grants to $ 7,641,000 and in loans to $ 19,547,000.

For Mine engineering see Department E; for Railway engineering, page 136; for Harbours, page 149.

Land and Coast Surveying, etc. Maps and Charts*.

Land Surveying. The principal charge of this service is in the hands of the *Royal Board of Land-surveying.* Subordinate to this board are, in each province, one Chief Surveyor and a number of Assistant Surveyors and elèves, who determine the »divisions» especially between neighbouring villages and farms, the marking out of boundary-lines, surveying and division of fields, etc. Only the Chief Surveyor has a fixed pay; the others are paid according to the estimate of the work performed. Charts and documents belonging to all work executed are to be deposited in the Surveying-office of the province, the head of which is the Chief Surveyor. Besides his general duties, as surveyor, this functionary has the charge of all the maps and documents, as well as the supervision of all surveying-work within his district. Respecting this, he has to send in a yearly record to the Board. In the northern provinces, where portions of the Crown Forests are, under certain conditions, let out to private persons (»afvittring») and where the concentration of smaller lots of property into larger complexes (»storskifte») still is practised, special surveyors with a fixed salary and not subordinate to the Chief Surveyor, are engaged. The whole personnel of surveyors amounted in 1891 to 542.

The expenses for surveying assistance paid by private landowners amounted in 1891 to $ 172,668. Besides, $ 8,955 were granted by the Government for the same purpose.

For the above mentioned institutions of »afvittring» and »storskifte» the Government expenses were in the above year $ 21,788, and, during the whole period 1803—91, $ 2,281,045.

The Economic Survey of Sweden. For the geographical survey of the Swedish country parishes, a work which formerly appertained to the Central Landmeasuring Office, a special office, The *Economic Survey of Sweden,* was instituted in 1859, with the object of obtaining an accurate knowledge of the area of the country, and of its natural divisions, from an economical point of view.

This office, under the management of the Topographic division of the Staff General, is divided into two departments, namely, the general, for the southern and the middle parts of the country, and one specially for Norrbotten, which comprehends the northern part of the country. The maps of the former department are on the scale of 1 : 20,000. The maps of Norrbotten, which have also a topographical object, are made partly on a scale of 1 : 50,000 and partly on one of 1 : 100,000. Although the surveys for these maps are continued at the expense of the State, the publication of them will depend upon the communities and private individuals, who must defray the expenses.

Up to this time lithographic maps on the scale of 1 : 50,000 have been published by the general office of the Economic Survey, of 6 provinces in the southern

* Partly by the Chief of the Topographic division of the Staff General.

and middle parts of Sweden (64,000 square km.) and by the Economic Survey of Norrbotten on the scale of 1 : 100,000 the province of Norrbotten (100,000 square km.). — The total grant in the budget is somewhat more than $ 27,000.

Topographical Survey. A special office of survey of Sweden called »Fältmätnings Corpsen», latterly, »Topografiska Corpsen», was organized, commissioned to prepare a complete topographic map of the country. Since the beginning of the year 1874 this corps has, continuing its former charge, been joined to the Staff General.

The *method of projection* is that called the increasing conical. The meridians are indicated by straight lines, and the parallels by concentric circles. The cone, by the development of which the surface of the maps is obtained, cuts the terrestrial spheroid along two parallels, 56° 57′ 31·5″ and 64° 22′ 56·5″, by which the error of projection is equal to zero (o). For the (since 1886) published topographical maps of Norrbotten a somewhat different method of projection is applied, viz. the cone cuts the terrestrial spheroid in every half-degree of latitude. The meridian which passes at 5 degrees to the west of the observatory of Stockholm, and which, coincides correctly enough with the middle meridian of the Scandinavian peninsula, is adopted as the principal meridian.

A triangulation of the first order contains the total coasts of Sweden and the frontier towards Russia, and is moreover accomplished in 6 chains along different parallels. By triangulation of the second and third order, between and within the chains of the principal triangulation, a number of points sufficient for the atlas, have been obtained.

The Stockholm observatory is the initial point of the whole Swedish primary system. Further, for the sake of control, the polar altitude has been ascertained at different times, at several trigonometrical points; the position of the net is fixed by azimuthal determinations of one of the sides of the triangle, extending from the Stockholm observatory, and of several other points of the system. Of the *bases,* determining the length of the sides, six may be considered as being equal to the demands of the present times, with regard to exactness.

During the last three decades, a beginning has been made for a complete *hypsometrical* measuring. For fixing the average height of water in the Baltic and the Kattegat, levellings have been executed with the most minute care. All these levellings refer to a benchmark in Stockholm situated at 11·67 m. above the average height of the water. To attain a more minute exactness in this respect than former hydrographic observations from the light-houses have been able to afford, there have been erected several self-registering gauges in different coast stations, connected with each other through the above mentioned precisive level-lines, from which proceed numerous detailed levellings, by means of which the number of points necessary for the maps are determined. In addition, trigonometrical levelling has been combined with the triangulated surveying.

The *scales* of the different maps are: for the general map 1 : 1,000,000; for

the maps of Norrbotten 1:200,000; for the special maps 1:100,000; for the original maps (sketch on the field) 1:50,000 and 1:100,000; for the hypsometric map of Sweden 1:500,000. For special maps of certain positions and localities, is used a scale of 1:20,000, or 1:10,000, and even larger, according to the object of the map.

The special map (of 1:100,000) is divided into rectangular sheets of 594 millim., by 445 millim., and the *map of Norrbotten* in sheets limited by meridians and parallels; the height of the sheets is $^1/_2$ degree of latitude and the length, $1^1/_2$ degree of longitude. Each map receives its name from the most important town or locality situated on the same.

For the topographic maps have been employed groundworks (stomkartor), to which all the suitable geometrical maps have been transferred on the scale adopted for the sketches on the field, and afterwards connected with each other by the aid of the trigonometrical points. Latterly in those districts, where the operations of the office of the Economic Survey precede the military surveys, the maps of the Economic Survey have been reduced to the scale of 1:50,000 or 1:100,000 and the topographic surveys effected on a copy of these reductions.

The surveys for the military atlas were for some years first made on the scale of 1:20,000 for Skåne and afterwards on the scale of 1:100,000 until the year 1844, when the scale of 1:50,000, which has been in use since that time, was adopted.

The special maps on the scale of 1:100,000 were at first kept secret, but in 1857 their publication was permitted. To the present time, have been published 78 sheets containing together 135,000 square km., and of the map of Norrbotten 28 sheets containing 85,000 square km.; or together, 220,000 square km. or the half of the total area of Sweden. Since the year 1865, the general map on the scale of 1:1,000,000 has been in hand. It is to be published in 3 sheets, of which two are already completed, and the third is being engraved. Of the hypsometric map of Sweden the southern part of the country has been published in a chromolithographic edition. In addition, the topographic division is occupied in drawing up military maps on a larger scale, for the purpose of exhibiting strategetic points of importance. These are kept secret.

An annual grant of S 20,000, reckoned from the beginning of the year 1875, has been assigned in the budget, for the topographic work of the Staff General, exclusive of salaries of staff-officers, who are employed in topography.

Several private cartographers have, with the pecuniary assistance from the State, published maps of Sweden. Thus there are: by Major N. J. T. Selander, a map in 14 sheets of the whole country on the scale of 1:500,000; by Dahlman, of the province of Vesternorrland in 4 sheets on the scale of 1:200,000; by Kellerstedt, of the province of Vesterbotten in 6 sheets on the scale of 1:250,000; by L. E. Åhrman, a map in two sheets of Gestrikland on the scale of 1:100,000; by P. Widmark, a map in one sheet of Helsingland, on the scale of 1:200,000;

by Albin and by T. F. Nordbeck, a map of the province of Jemtland in 15 sheets on the scale of 1:200,000.

E. G. Ljunggren has published a map of the towns of Sweden and their territories.

The Geological Survey of Sweden was established in 1858. The principal object of this institution is to examine the geognostic relations of the country, with a threefold view of scientific, agricultural and industrial investigations, and to publish the results by means of maps and detailed descriptions. The grant, annually voted by the Diet for this purpose, has gradually been increased from $ 16,000 to about $ 24,000. Besides this, the institution has received contributions from the Association of Swedish Iron-Masters and several Agricultural Societies for the purpose of practical geological researches and mapping of certain mining and agricultural districts etc.

The functionaries permanently employed in the geological survey are 12, the director included. In the summer, when the field work is carried on, this number is more or less increased by the employment of assistant geologists. The winter months are devoted to the construction of maps, to the preparation of descriptions and monographs, to microscopical studies, chemical analyses etc., all of which is done in the office, situated in Stockholm and called the *Geological Bureau*. In the same building is a museum, which includes two departments, the one containing collections of raw materials and products from the mineral kingdom, the other purely scientific collections.

At the establishment of this institution was decided, that the geological maps should be published by lithochromotypy on the scale 1:50,000 and in sheets, comprising about 661 sq. kilom. or 255 square miles. The maps were based, partly on photographic copies of the original maps of the Staff General, partly on the »economic maps». This plan of working was carried on until 1880, when it was prescribed to use the scale above mentioned only in certain parts of southern Sweden, and that all other parts of the country should be surveyed on the scale 1:100,000 with the printed topographic maps as a base, and the geological maps should be published on the scale 1:200,000 in sheets, comprising 2,641 sq. kilom. or about 1,020 sq. miles. These two kinds of maps show, not only the uncovered rocks in all their varieties, but also the different quarternary deposits, which are very carefully examined with regard to relative age and character by the study of sections and by means of numerous earthborings. At present there are also published geological maps of the quarternary deposits, printed directly on the topographic maps (1:100,000), and it is proposed to apply this new system to large areas of the country.

About 96,000 sq. kilom. (37,000 sq. miles) or 22 per cent of Sweden has been at present surveyed in detail, in the manner above described. Besides this, geological, general maps on the scales 1:2,000,000, 1:500,000 and 1:1,000,000 have been compiled, but only the southern third part of the last mentioned is yet published.

The Geological Survey of Sweden issues three different series of publications, viz. Ser. A, The ordinary sheet maps with descriptions; Ser. B, General maps and detailed maps; Ser. C, Monographs and pamphlets. Hitherto have been published 111 maps on the scale 1:50,000 (Ser. A a) generally; 15 maps on the scale 1:200,000 (Ser. A b); 4 General maps (Ser. B a); 7 Special maps with descriptions, (Ser. B b) of farms, iron bearing districts and important iron mines; 127 Monographs and papers, (Ser. C.) Among the last mentioned, 18 deal with the geology of archæan and præcambrian deposits, 13 with pure chemical and petrographical examinations of rocks, 51 with palæozoic and mesozoic deposits, 31 with the glacial period, 12 with ores and other productive minerals and 11 with the stone industry. For Mine surveying and maps, see page 104.

Hydrographic Survey. The *Royal Hydrographic Office* in technical and other points of view belongs to the Department of the Navy, and its principal duties are as follows:

1:o. The hydrographic surveying, on convenient scales, of the coasts and larger navigable lakes of the country; the sounding of lakes, shoals and sands, and the general exploration of the navigable waters surrounding the coasts, accordingly as such may be found necessary for the navigation and defence of the coasts; preparatory work for nautical mapping, such as triangulation, magnetic observations etc. according to the requirements of the office, and where such work has not been previously done with sufficient accuracy.

2:o. The publishing of charts etc. comprising the construction of original maps and their reproduction by engraving or other suitable means, to be supplied to navigators; the drawing up and publishing of descriptions of channels and coasts etc. for navigation.

The staff of the Hydrographic Office consists of one chief and the requisite number of commissioned officers and assistants. To serve on the annual hydrographic expeditions are also ordered as many naval officers as may be required.

Previous to the year 1860 the hydrographic surveys were made principally by means of sailing vessels and rowing boats, but since that year steamers have been used. The use of steam, naturally, has considerably expedited the hydrographic work and at the same time has contributed much to its accuracy. The varied nature of the Swedish coasts, and the cluster of islands and skerries (»skärgårdar») fringing them, has made it necessary, however, to use vessels greatly differing in size and power, and adapted to the different localities. Lately the vessels employed have been 3 larger steamers and 7 steam launches. An area of about 600 square kilometers have been annually surveyed and mapped.

The hydrographical charts of archipelagos and lakes are constructed on the scale of 1:20,000. The projection is conical, or the same as used by the General Staff on their maps. The soundings near the coasts and in sight of land are mapped on the scale of 1:50,000, and deep-sea soundings generally on the scale of 1:100,000. To meet the requirements of the maritime trade the Hydrographic Office

also publishes charts on the scale of 1:100,000 and 1:200,000, comprising all the waters round the Swedish coast, and also special charts on scales of 1:50,000 and 1:100,000. All charts are revised every year. The charts published by the Hydrographic Office comprise only the Baltic, with its gulfs and bays, the two Belts, Cattegat and Skagerack as far as Lindesnaes in Norway, also the Göta Canal and the lakes joined by the same.

Under the title of »Den Svenske lotsen» (The Swedish pilot) the Hydrographic Office also publishes sailing directions for the above named waters; new and revised editions of which appear when required.

For *Government and Law* (classed as Group 153) see the Introduction, page 21. Here we will simply say a few words upon a matter closely connected with the development of the trades, viz.

Protection of Property in inventions.

The present Patent Act is dated May 16th 1884 and founded on the principle of preparatory examination of novelties. A patent is granted for a period of fifteen years. On giving in the application for a patent, a sum of 50 crowns ($ 13·40) is paid, which sum, however, dating from 1894, will be reduced to 20 crowns ($ 5·36). The number of patents granted during the following years has been:

In 1885	206	In 1889	466
» 1886	464	» 1890	605
» 1887	520	» 1891	706
» 1888	494	» 1892	699

All authority concerning patents in Sweden is held by the *Royal Patent Office,* consisting of a head and a chief engineer, besides other officials and assistant engineers. It devolves on the Patent Office to register *trade-marks* according to the enactment of July 15th 1884. In 1892 the receipts of the Patent Office amounted to rather more than $ 29,000, its expenses being a little more than $ 23,000.

Dating from July 1st 1885, Sweden has assisted in the Convention which was signed by several States in Paris on March 20th 1883, concerning international protection for industrial proprietary rights.

Institutions and Organizations for the diffusion of knowledge.

Academies and Learned Societies. Sweden has seven academies (all in Stockholm) and various learned societies, of which institutions the following are the chief:

The *Swedish Academy*, established in 1786, which, while developing and giving to the Swedish language a definite form, has for its special object the spreading and extolling of the glory and memory of the great men of Sweden. The Academy has just commenced its largest work, »The Dictionary of the Swedish Language», intended to be begun in 1893 and to be completed in forty years. The Publications of this institution (1786—1892) form 73 volumes. The number of the members of this Academy is limited to eighteen.

The Royal Academy of Sciences, established in 1739 by Linné and other scientific men, has for its object the promotion of physical sciences and mathematics. The members number one hundred Swedes and seventy-five foreigners. Under their supervision is the State Museum of Natural History with six superintendents (see page 231); there are moreover natural philosophers and other officials for the Observatory of the academy (the Stockholm Observatory). The academy has the exclusive right of publishing almanachs in Sweden, and also the official State Calendar. Dating from 1872, the Meteorological Central Office — which exercises control over all the meteorological stations of the State and annually publishes a report concerning observations made — is also under the Academy of Sciences. The publications of this academy are Proceedings (from 1739), Reviews (from 1844), Supplements (from 1872). The Annual Record concerning the progress of science (1821—59), Speeches, and other series are now no longer issued.

The *Royal Academy of Literature, History, and Antiquities*, founded in 1753, has at the most ten honorary, twenty-five active, and not more than twenty foreign members. The Academy publishes »Proceedings» and two periodicals, mostly on archæological matters.

The *Royal Academy of Agriculture* has been spoken of on page 47.

The *Royal Academy of Fine Arts*, founded in 1735 and instituted for the careful direction and promotion of the development and progress of painting, sculpture, architecture, and other plastic arts in Sweden, has one president, at the most twelve honorary native members, and fifty Swedish as well as an unlimited number of foreign members, women artists, and associates. A School of Art is connected with the academy, which in 1890 was granted the sum necessary for a new building.

The *Royal Academy of Music*, founded in 1771, has at the most 100 native members, of which twenty may be women, and not more than fifty foreign members. The academy has a grant of about $ 12,000 from Government and has, moreover, munificent donations, as also an extra grant of $ 1,600 given by the Diet for encouraging composers. A Conservatory of Music is connected with the academy.

The *Royal Military Academy*, founded in 1796, has in view the promotion of military science. The native members are divided into two classes; the first consisting mostly of generals, admirals, and persons of the same rank (at present

47), and the second 120 at the most. The number of foreign members is not fixed (at present 16).

Besides the above Stockholm *Observatory,* there are similar institutions at the two universities of *Upsala* and *Lund.*

Among the *Learned Societies* may be mentioned:

The Royal Society for the publishing of Manuscripts relating to the History of Scandinavia (founded in 1817) in Stockholm; the Royal Society of Sciences, at Upsala (the oldest scientific society in Sweden, founded in 1710); the Royal Physiographical Society at Lund (1778); the Royal Society of Sciences and Belles Lettres at Gothenburg (1778); and the Royal Naval Society at Karlskrona (1771).

Among these may also be mentioned the Society for publishing Swedish Mediæval Literature; the Swedish Society of Physicians; the Society of Apothecaries; the Society of Gardeners; the Pedagogical Society; the Society for promoting Fine Arts; the Antropological-Geographical Society, that annually presents a medal to some geographical explorer (see page 239); the Geological Society; the professional unions at the universities, etc.

Museums and Collections. The largest of these is the *National Museum* in Stockholm, a large building erected 1845—1863 at a cost of $ 624,000 and opened in 1866. The collections embrace works of art in statuary and painting as well as other objects (vases, porcelain, furniture, ivory articles, mosaics, enamels, etc.), and besides, a historical division and a cabinet of medals (see Dept. M.) The collections of art, both of ancient and modern masters, have been greatly increased in recent times by purchases and donations both from members of the Royal Family and other donators. At present the museum possesses 1,450 oil paintings, close upon 100,000 engravings and sketches, 850 works of sculpture of marble and bronze, besides antique vases, terracottas, Egyptian antiquities, etc. The *Royal collection of arms*, armour and dresses contains many historical relics of our kings, many of the specimens displaying the highest standard of art industry.

The *Royal castles* of Gripsholm and Drottningholm include collections of art, the former specially historical portraits, the latter, furniture and objects of art, both »baroque» and »rococo».

Among private collections of this kind may be mentioned, before all, those at *Skokloster* castle, where are preserved a great number of objects of industrial art, mostly brought together during the Thirty Years' war by the Field-marshal C. G. Wrangel, the then owner of the castle. Several other private castles as *Vanås, Säfstaholm, Finspång,* etc. possess noteworthy collections of paintings.

The *Museum of Natural History,* under the supervision of the Royal Academy of Sciences, in Stockholm, is divided into six sections, with a superintendent for each, namely, for vertebrates and lower non-vertebrated animals, as well as entomological, palæontological, botanical and mineralogical sections.

Important collections of natural objects are also to be found at the *univer-*

sities of Upsala and Lund, in *Gothenburg*, and at most of the schools for secondary instruction. — For the archæological and etnographical museums compare Department M; for geological collections, see page 227.

The Swedish Tourist Club, founded in 1885, is working for the development and facilitating of tourist travelling in our country, and for the diffusion of due knowledge of Sweden and its people.

One of the first measures taken by the Club was to call the attention of tourists to the alpine parts of Sweden, as yet nearly unknown even to the greater part of the Swedish public. Situated chiefly in the northern part of the kingdom, traversed by magnificent water-courses, during summer time bathed in the light of the midnight sun, and inhabited by the nomad Lapps that rove about with herds of reindeer, the Swedish alps furnish a tourist-district of surpassing interest, although formerly somewhat inaccessible on account of insufficient means of communication. In many parts of these districts, roads have now been constructed by the Club, boats have been stationed by the rivers, shelters for tourists have been built, etc. Special efforts have been made by the Club for facilitating the access to two waterfalls, situated in these parts of the country, viz. Harsprånget (Hare's Leap) and Stora Sjöfallet (the Great Lake Fall), not only the largest falls in Sweden but also ranging amongst the most remarkable in the world. The Club has made similar arrangements in other parts of the kingdom by the erection of prospect towers, the placing of road-signs, the procuring of guides, etc.

For exciting the interest of foreigners for tourist travelling in Sweden, printed matters regarding Sweden are distributed on the Continent by the Club, albums with photographic views from Sweden are placed in the reading-rooms of the hotels, conferences and exhibitions are arranged, etc.

The Club has, for the special benefit of its members, made arrangements for reduced prices with a great many hotels, steamers, and purveyors of tourist equipment, and, in the most important places of the country, proper persons have been appointed as agents of the Club for the purpose of giving advice and information to its travelling members. The Club also furnishes its members with tents, maps, etc. for travelling in remote parts of the country.

Finally, a handsomely illustrated »Year-book of the Swedish Tourist Club» is issued by the Club and gratuitously distributed to members.

Music and Drama.

The fact that the Swedes are a musical people is best proved by our national melodies, our songstresses, and our students' choruses being each in their kind admitted to be the finest in the world. Rossini is stated to have declared that such a melody as »Necken's Polska» neither he nor any other composer then living could have written. Jenny Lind was the most gifted singer that any country has ever produced, and other Swedish songstresses have won a world-wide cele-

brity, e. g. Christine Nilsson. In 1867 at the Exhibition in Paris when the Upsala Students' Chorus carried on the competition in singing, it was unanimously adjudged the first prize, in preference to all others.

Singing and its cultivation generally forms the focus of musical life. Ever since the Opera was founded, in 1773, it has had plenty of good voices, more especially sopranos and tenors. Tuition in singing is compulsory in all schools, except for those who prove totally destitute of musical inclination. Several Swedish »Ladies' Quartettes» have toured abroad with great success, and there are a great many quartettes of male voices all over the country; every society, association, and workmen's club having a chorus of their own. Choruses of mixed voices are to be found in the capital and in all large country towns. — Instrumental music, though pretty general, is not cultivated to the same degree as singing. The ancient instrument with the peasant performers, the hurdy-gurdy with bow, has long ago given place to the violin, which now unhappily has been partly ousted by the accordion. The Swedish organ-building has been renowned from days of yore and of late years the manufacture of pianofortes has made rapid progress. In 1891 the export of musical instruments was close upon $ 10,000, though the import runs to a far higher amount, being last year computed as more than $ 100,000.

The gift of song in Sweden is not only proved by its execution but also by the devising and composing thereof. That a country like ours, which possesses the very best quartettes of male voices in the world, can produce a flourishing collection of quartette compositions is quite a matter of course, and our most celebrated composers in this line, O. Lindblad and G. Wennerberg, have written productions that are peculiar to Sweden. The Swedish ballad composers, represented by Åhlström, Nordblom, A. Lindblad, Crusell, Geijer, Josephson, Prince Gustaf, Söderman, Sjögren, etc., occupy a relatively elevated position and include most of our composers. Symphony and Chamber Music has been cultivated far less, composers of this kind of music being F. Berwald, Norman, Andersen, E. Andrée, Dente, Rubenson, Åkerberg, Aulin, etc. Operas have chiefly been composed by foreigners who have settled here, as Naumann, Kraus, Hæffner, Du Puy, Brendler, Foroni, Henneberg, Saloman, and, but very rarely, by our own countrymen, Hallström having tried to combine northern melody with the French style, and Hallén to introduce Wagnerism, which attempt however has met with no great success.

The Royal Academy of Music is spoken of on page 230. The *Mazér Club* is an association for the execution of chamber music. The *Musical Art Association* publish works by native composers, while an *Association for the promotion of quartettes* encourages, by competitions, compositions of this kind for male voices.

Of the theatres, the *Royal Swedish Opera* has a grant of $ 16,000 from the King, and a similar sum from the Diet, while the only other theatre ever favoured with any grant has been the *Dramatic Theatre*. All other theatres are under private management, and it is only in Stockholm and Gothenburg that there are permanent troupes, all other towns being simply visited by itinerant players.

DEPARTMENT M.

ETHNOLOGY, ARCHÆOLOGY, ETC*.

At a very early period in Sweden, native antiquities had become an object of interest and study. Thus we find that the great Gustaf II Adolf in 1626 issued a 'Memorial', concerning the duties incumbent on the Royal Antiquaries. It is, however, of interest to see that among the numerous and minutely specified duties of the Royal Antiquaries no mention is made of the collection of antiquities found in the earth, which nowadays are so particularly sought for preservation in museums. On the other hand great weight is laid on the careful preservation of manuscript antiquities, amongst which may be especially noted runic stones and runic wands, and the collection of all information concerning them is also very definitely laid down. It is undoubtedly a peculiar circumstance that as early as the first half of the seventeenth century, one division of our antiquities was placed under the charge of a government official.

Yet a step further in this direction ws the erection in 1667 of the *College of Antiquities*. To the members of this College was given the same obligation which formerly attached to the Royal Antiquaries, but its field was enlarged in that, besides the care of manuscript antiquities, so great an interest was also shown for the stone monuments and barrows, that these were taken under the protection of the law.

If we examine the operations of the men who were members of this College, we find that they almost exclusively devoted their time to manuscript antiquities. They published and interpreted Icelandic manuscripts concerning Scandinavian history, they sought after, copied and translated our old runic inscriptions, they published the old Swedish provincial laws etc. Of the members of the College we will here mention but two of the most noted, Johan Hadorph (d. 1693) and Johan Peringskiöld (d. 1720). They obtained pre-eminence in their study of archæology, in its strictest meaning, by their excellent collection of reproductions of runic stones. The engravings were in wood, but appeared first in 1750 when they formed part of a collection of rune-stone reproductions published by J. Göransson under the title »Bautil».

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* By Dr. K. B. Salin.

The most prominent of Swedish archæologists during the 17th century was, however, Olof Rudbeck. (d. 1702). We, in this nineteenth century, have a difficulty in understanding the great reputation enjoyed in his time by Rudbeck. He was one of those restless geniuses who wish to be omniscient. He was an anatomist, a botanist, architect, antiquarian, poet, and at the royal fêtes was employed as director and as a singer. Here we are naturally interested simply in his archæological pursuits. These were of the greatest importance for Swedish archæology because he exercised a decisive influence, not only on his own period, but also on many following generations. In the great European conflict between Protestantism and Catholicism, Sweden had taken a decisive part and made the former victorious, and was amongst the leading European Powers. National feeling was raised by these successes to an incredible degree, and old Swithiod (Sweden) must be foremost in everything. Even before, it had been considered that Swithiod must have been the cradle of a very ancient culture which thence spread over the rest of Europe, but now Olof Rudbeck put it into system. With his prodigious learning and incredible energy he began to gather scientific evidence for the assertion that Sweden had been the cradle of Europe, from whence, by slow degrees, culture had proceeded to the other countries of the continent, — he went so far as to assert that Swedish soil had nourished the groves of Paradise. Evidence to prove these and other such assertions he brought from all possible sciences, — geology, astronomy, etymology, etc. The fantastic erections of his erudition awakened contemporary enthusiasm, the world admired its beauty and richness, and was amazed and enraptured with the far glimpses from its battlements into the shadowy land of the past. It was considered disloyalty to doubt Rudbeck's imaginings. But little by little people began to give expression to their disbeliefs, eventually going diametrically opposite to the former admiration by denying the worth of all Rudbeck's work.

The 17th century was far more favourable to the study of archæology than the one which followed. The first decades of the 18th century were full of disastrous wars, followed by years of political strife which diminished the energy of the nation, and the influence of the French Illuminatists on the later decades can not be said to have been favourable to this science.

It is first at the beginning of the present century that we have something of interest to note. It is, that about this time, N. H. Sjöborg, professor in History at the university of Lund, commenced to collect antiquities and to lecture upon them. A number of students were attracted to him, of whom some afterwards rose to eminence in archæological pursuits. Sjöborg's influence was due in a lesser degree to his zealousness in advancing his theories, and to a greater extent, to his (for that period) great zeal for collecting antiquities. He succeeded in calling into life a very wide spreading interest in archæological pursuits.

Sjöborg's work in Lund was continued by Sven Nilsson, one of Sweden's most distinguished men of science. He was peculiarly a naturalist, and in conse-

quence introduced the methods of a naturalist into the study of antiquities, thus founding comparative archæology». He did not seek an explanation of the antiquities from old writers but studied the different forms and appearances of the objects in the whole, comparing them with one another and with objects from other countries, where people still lived, or had lately existed, whose state of culture corresponded to that represented by the antiquities in question. By this means he could arrive at a correct result, under the supposition naturally of a sufficiently large material for comparison. This was in his days sometimes wanting and is the reason why all of his theories are not approved by later inquirers, — but, without contradiction, he takes an especially prominent position amongst the archæologists of Sweden.

In order to pursue the method introduced by Nilsson, an acquaintance is required with a vast material. It will therefore be of utility, before further inquiry into the later development of archæological research, to examine a little the Collections of Antiquities, which have been the consequence, and at the same time the possibility, of extensive and exact scientific investigations characterizing the modern study of Archæology in Sweden.

The principal collection including objects found in Sweden, is that of the *National Historical Museum,* and must be so considered both because it is the oldest, and because it contains the most noteworthy and valuable gathering of antiquities in the country. The College of Antiquities we have before mentioned, had, amongst other duties, to establish a »sheltering place for the antiquarian objects which might be dug up from the soil», and already in the year 1670, the College had received a number of objects which are now deposited in the National Historical Museum and were the nucleus of the collection there. In the beginning the collection grew but slowly, so that in 1700, after an existence of 30 years, the gathering numbered but 10 objects from the stone and the bronze periods, about 400 from the iron age, and 80 representing the Middle centuries of our period. During the next hundred years the collection increased but gradually, and during the first decades of this century it was not even the largest in the country. The merit of devoting untiring energy to its development, belongs in an eminent degree to B. E. Hildebrand, the Royal Antiquary, and the rapidity of its growth beneath his care, may best be shown by figures. During the period which elapsed between the years 1801 and 1825, the collection was increased by 3,670 objects, while, for example, in the single year 1874 no fewer than 6,954 antiquarian objects were added. In later years, his son, Dr. Hans Hildebrand, as Royal Antiquary, has furthered this development in the highest degree, — the number of additions added to the museum in 1890 being no less than 9,200.

Some other figures may be given to show the richness of the mine of Swedish Antiquities. From the year 1822 until 1874 there were purchased for the National Swedish Museum 54 collections of antiquities, formed by private persons in different parts of the country and containing 18,538 objects, the yearly increase of objects thus

being about 375 in number. During the three years 1889—91 we have the corresponding figures 3,135 (1,000 in average annual increase) of objects obtained from similar sources. In consequence of the energetic development of the National Historical Museum during the greater part of this century, it has taken a foremost place, not only amongst Swedish museums, but also amongst the most important European collections.

The Museum has sections devoted to the three periods of early civilization. In the room illustrating the Stone-age is one of the finest collections of stone implements to be found in Europe. The implements from the Bronze-age are often noble in form and artistically ornamented, and, finally, the objects representing the Iron-age are of the finest workmanship, especially so where gold or silver have been the materials employed. As regards the relics from the »Vikings», the museum holds the very first place, and the same may be said of the collection of objects from the Scandinavian Middle age.

The Museum of next importance in its collection of Swedish Antiquities to the National Historical Museum, is, at present, the *Historical Museum* belonging to the University of Lund, the total of the objects amounting to about 10,000. The Stone-age is especially richly represented, and most naturally, since Skåne was the province first peopled in our country.

Besides the above named Museums, there are in various provincial towns a number of larger or smaller collections numbering perhaps 25. The greater number of these date back but two or three decades.

But we shall now return to the survey of the growth of archæological research, which was a consequence of the study of the important collection gathered in the Museum. In the first place we must notice Sven Nilsson. Through his studies he became convinced of the correctness of the »three-period» theory originating in Denmark, and he succeeded, by means of his many writings, in throwing a light upon the different conditions of culture existing during the Stone and Bronze periods, — and by this means exercised a very great influence upon his contemporaries. And of further great importance for Swedish Archæology was the circumstance that B. E. Hildebrand, who had studied the 'three-period' theory in Copenhagen, afterwards in Sweden arranged, first the Lund Museum, and then the National Historical Museum according to that system. As a result the officials at the museums were obliged, in arranging newly acquired antiquities, to closely study the form and character of the object, in order to determine with certainty to which of the three periods it belonged.

It was immediately found, by this method, that certain forms were related to each other, while others were clearly distinct. Thus the cognate forms are arranged in such a series of closely related modifications that their development may be traced from their earliest appearance to their extinction. By this means the science advanced to the typological method of investigation, which afterwards became very much discredited, perhaps mostly because people did not wish to

understand it. However, it appears to be the only praetieable method to follow, if one wish to explore the domain, yet so little known, of aneient times. This method of investigation is undeniably one of the most prominent features of later Swedish Arehæology. The most eminent leaders in this development are the aforenamed Hans Hildebrand and Professor Oscar Montelius, who by this means have exereised great influence upon arehæologieal researeh.

Hildebrand was one of the first who made an attempt to study the eulture-relationship existing between the various European peoples during the pre-historic period, and he may be called the first who distinguished Hallstatt and la Tène eultures from each other. During latter years he has ehiefly devoted himself to the study of our Middle Ages with a view of delineating the eivilization of that period, but, notwithstanding, he has not abandoned his pre-historie researehes, and at intervals enriehes archæologieal literature with valuable accounts of the most varied nature.

Montelius has principally been engaged in chronological work, in whieh he determines the relative age of antiquities as to the three ehief periods, and after this tries to fix also their absolute age. The most renowned of his investigations, whieh coneerned the determination of the limits of the Bronze-age, experieneed at the outset a very strong opposition from many quarters, but by degrees his views have been aeeepted, even by his strongest opponents.

The *Royal Academy of Literature, History and Antiquities*, founded in 1786, which at present has the supreme care of the preservation of our arehæological remains, edits three different series publieations, of whieh, however, two appear at indefinite periods (see page 230).

Ethnographical research has not, in Sweden, a like age with archæological investigations, but it is pursued at the present day with the utmost energy. Certainly, no stranger who has visited Stoekholm within these latter years, has neglected seeing the '*Nordiska*' *Museum*, formerly entitled »The Scandinavian Ethnographical Colleetion». The whole of this magnifieent eolleetion has been brought together, solely, it may be said, through the efforts of one man, Dr. A. Hazelius, who in 1873 opened his museum to the publie. It has been his aim to present a picture, eomplete as far as possible, of Scandinavian life and culture during past eenturies. Doctor Hazelius laboured, espeeially at the commeneement, not so mueh to illustrate the life of the higher and wealthier elasses, but endeavoured principally to show the eonditions under whieh the peasantry existed, and the eolleetion fully carries out his design.

By means of arranging in the museum interiors of peasant-eottages in whieh stood wax figures dressed in national eostumes, he sueeeeded in awakening a great general interest in the colleetion, and probably few enterprises in our eountry have reeeived such publie support.

The contents of the museum have greatly increased. In 1873 the objects numbered 3,840, in the next year they were supplemented to the extent of 2,000 more, and at the close of 1875 the collection amounted to 10,092 various objects. The growth since then has been rapid, and in 1880, the museum contained 26,000 objects, increasing by the end of 1890 to 67,000, and in 1891 to 71,856. These figures, however, do not exactly represent the total number of objects in the collection, since many articles are duplicated, some being represented by as many as one hundred specimens.

Many publications have been issued by Dr. Hazelius concerning the Museum and those interests which he has made it his aim to promote.

Compare Catalogue I, page 60.

Although Sweden has no peculiar naval importance or colonial mercantile intercourse to any large degree, still the country's interest in the conditions of culture in other European countries has been so great that a very large ethnographical collection has been brought together.

Thus Baron NORDENSKIÖLD brought home a valuable collection from his celebrated journey round the world by the North-East passage,; in 1883 Prince Oscar undertook a cruise round the globe, accompanied by Dr. HJ. STOLPE in order to collect ethnographical objetcs. It is principally owing to these two collections that the Ethnographical division of the State Museum has such scientific value. During the past five years the collection has been increased by 8,675 objects, which number, however, includes those brought home by Dr. Stolpe.

As the collections have but lately become of any importance there has been as yet no great opportunity for scientific researeh regarding them. The Swedish *Anthropological and Geographical Society* publishes a magazine 'Ymer' in which are found many ethnographical articles. Prominent amongst these may be mentioned Doctor Stolpe's account of his investigations of the ornaments used by uncivilized races, in whieh he has used the typological method before mentioned. In general, Sweden is poor in ethnographical works, but there may be mentioned Düben's work 'Lappland', and Retzius' important work on 'Finnish Skulls' should also be named.

For **Woman's Work in Sweden**, vide:

Reports from the Swedish Ladies' Committee to the World's Columbian Exposition at Chicago 1893:

I. Education.
II. Philanthropy.
III. Literature and Art.
IV. The Public service, Trade and Business.

The Social Condition of the Swedish woman, prepared with a design to the World's Columbian Exposition. A. D. 1893:

I. Survey of the social and legal condition of the Swedish woman from ancient times to the middle of this century.
II. A Chronological list of enactments passed in Sweden relative to woman from 1845 to the present time.
III. Information concerning associations for woman's rights in Sweden.
1) The association for the married woman's property right.
2) The Fredrika Bremer association, its leading principles and working system.
3) The Swedish woman's association for the defence of their country.
4) Trades Unions.